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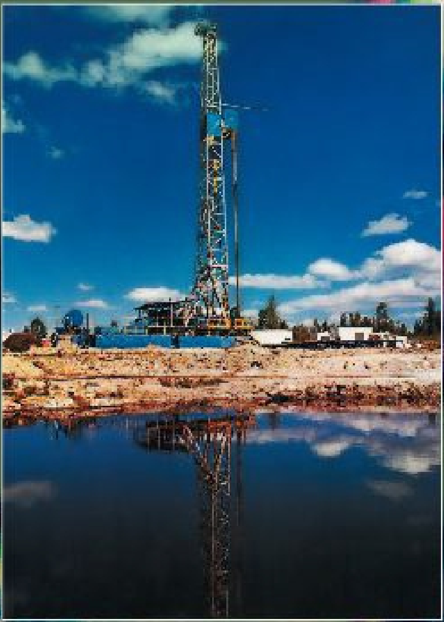

Volume 41 June 2004 Number 1

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Haec Credimus

For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh.—Exodus 20:11

Helium Diffusion Age of 6,000 Years Supports Accelerated Nuclear Decay

D. Russell Humphreys*, Steven A. Austin*, John R. Baumgardner, and Andrew A. Snelling*†**

Abstract

Experiments co-sponsored by the Creation Research Society show that helium leakage deflates radioisotopic ages. In 1982 Robert Gentry found amazingly high retentions of nuclear-decay-generated helium in microscopic zircons ($ZrSiO_4$ crystals) recovered from a borehole in hot Precambrian granitic rock at Fenton Hill, NM. We contracted with a high-precision laboratory to measure the rate of helium diffusion out of the zircons. The initial results were very encouraging. Here we report newer zircon diffusion data that extend to the lower temperatures (100° to 277° C) of Gentry's retention data. The measured rates resoundingly confirm a numerical prediction we made based on the reported retentions and a young age. Combining rates and retentions gives a helium diffusion age of 6,000 ± 2,000 years. This contradicts the uniformitarian age of 1.5 billion years based on nuclear decay products in the same zircons. These data strongly support our hypothesis of episodes of highly accelerated nuclear decay occurring within thousands of years ago. Such accelerations shrink the radioisotopic "billions of years" down to the 6,000-year timescale of the Bible. (§ is section of reference being cited.)

Introduction

Under the deep blue skies of northern New Mexico in the fall of 1974, drillmen labored to extract cores from a borehole called GT-2 (Figure 1) nearly three miles deep. The site was Fenton Hill, on the west flank of the Valles volcanic caldera in the pine-covered Jemez Mountains. Two dozen miles to the east, geoscientists at Los Alamos National Laboratory analyzed the drill cores, investigating whether the hot, dry rock would be suitable for providing geothermal energy.

The geoscientists identified the rock as biotite granodiorite, a granitic rock containing shiny flecks of a black mica called *biotite*. They crushed a core sample from a depth of 2,900 meters and extracted microscopic crystals of zirconium silicate ($ZrSiO_4$) embedded in the biotite. These crystals, called *zircons*, were radioactive, containing high amounts of uranium and thorium relative to the rest of the rock, as is usual for that mineral. Comparing two

Figure 1. Drilling rig for borehole GT-2 at Fenton Hill, NM. Photo: courtesy of Los Alamos National Laboratory.

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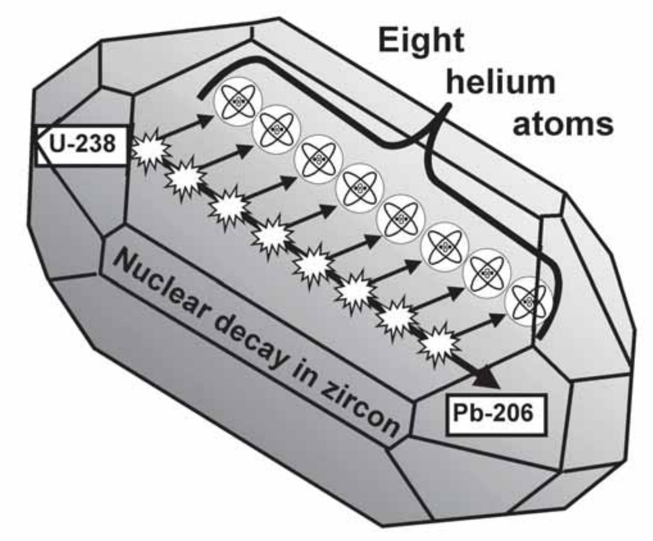

Figure 2. Uranium, lead, and helium in a schematic zircon. ^{238}U decaying to ^{206}Pb releases eight alpha particles (which become helium atoms) within the crystal.

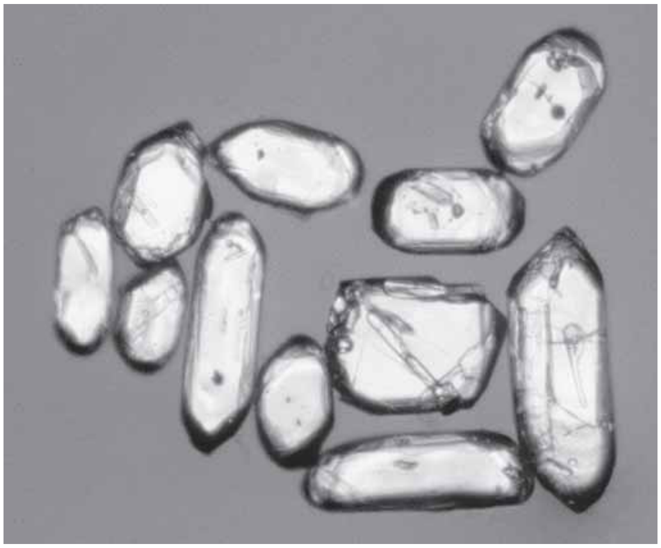

Figure 3. Zircons 50 to 75 μm long extracted by Gentry et al. **(1982a) from GT-2 core samples. Photo: courtesy of R. V. Gentry.**

isotopes of *radiogenic* (formed by nuclear decay) lead (^{206}Pb from ^{238}U and ^{207}Pb from ^{235}U), they determined that 1,500 ± 20 million years worth of nuclear decay had occurred in the zircons—assuming as usual that nuclear decay rates have always been constant (Zartman, 1979). The date is consistent with uniformitarian expectations for this Precambrian "basement" rock unit.

The zircons also would be expected to contain helium (^{4}He), which comes from the alpha particles (nuclei of helium atoms) emitted by many of the nuclear decays (Figure 2). This prompted Robert Gentry at Oak Ridge National Laboratory to ask the Los Alamos team to send him core samples from various depths in GT-2 (as well as samples from deeper boreholes nearby). Gentry and his team extracted zircons from the samples, hand-picked crystals between 50 and 75 microns long (Figure 3), and measured the total amounts of helium in them. From the amounts of radiogenic lead in the zircons, they estimated how much helium the nuclear decay should have deposited in the crystals. They found that "an almost phenomenal amount of He has been retained" in the zircons, despite them being small, hot, and allegedly old (Gentry et al., 1982a). Table I shows their results as samples 1 through 6.

Note carefully: Gentry's large retentions are *not* what uniformitarians mean by "excess helium" (Baxter, 2003), a common mental pigeonhole into which they shove helium anomalies. In the context of these zircons, "excess" helium would correspond to retentions *greater than 100%* of the amount nuclear decay could produce in 1.5 Gyr. We are not claiming such "excess" helium at all. As we explain in "Latest results arrive in mid-2003" on page 8 of this paper, the uniformitarian method of "helium dating," called *(U-Th)/He chronometry*, is entirely different from the helium *diffusion* dating we are employing here. Uniformitarian "helium dating" methods would not call attention to the large helium *retentions* we are concerned with, so it may be that sites like borehole GT-2 are common throughout the world.

RATE gets involved

When creationists became aware of Gentry's data, many of us thought that it would have been impossible for the zircons to have retained that much helium for even a million years, much less over a billion years. Helium is a lightweight, fast-moving atom that does not attach itself to other atoms, so it *diffuses* (spreads out) through the atomic lattices of most minerals relatively fast. However, we knew of only one published measurement of diffusion rates of helium through zircon (Magomedov, 1970). That report was sketchy and ambiguous, leaving room for quite different ways to interpret the numbers. There were no published measurements for helium diffusion through biotite, the mineral surrounding the zircons. Until we had reliable numbers for these diffusion rates, we could not say for certain that the large retentions require a young earth.

In 1998, the Radioisotopes and the Age of the Earth (RATE) steering committee began planning to do experiments to measure helium diffusion in the relevant miner-

Sample	Depth (m)	Temp. (°C)	He (ncc/μg)	Fraction	Error
2002	750	96	~12.1	~0.80	——
1	960	105	8.6	0.58	±0.17
2003	1490	124	6.3	0.42	±0.13
2	2170	151	3.6	0.27	±0.08
3	2900	197	2.8	0.17	±0.05
4	3502	239	0.16	0.012	±0.004
5	3930	277	~0.02	~0.001	——
6	4310	313	~0.02	~0.001	——

Table I: Observed helium retentions for zircons recovered from various depths in borehole GT-2 and others nearby, Fenton Hill, NM. Samples 2002 and 2003 were recovered for the RATE project and named for the years we analyzed them. Samples 1– 6 are those reported by Gentry et al. **(1982a). Column 4 is the total helium yield (1 ncc = 10^{-9}cm^3 at standard temperature and pressure) per microgram of zircon. Column 5 is the corresponding fraction of the estimated amount of helium deposited in the zircons by nuclear decay. Column 6 is the estimated error in the fraction. All zircons were of length 50–75 μm, except for those from sample 2002, which were not sorted into size groups.**

als. RATE (Vardiman et al., 2003) is a research initiative started in 1997 by seven scientists from three major creationist organizations: the Institute for Creation Research (ICR), Answers in Genesis (AiG), and the Creation Research Society (CRS). In 1998 a personnel transfer reduced the sponsoring organizations from three to two, ICR and CRS. Three board members of CRS have been on the RATE steering committee from the outset: Donald DeYoung, Eugene Chaffin, and Russell Humphreys. CRS members have supported the project by designating donations to the RATE research fund administered by ICR.

The charter for RATE was to make a focused investigation of the problem posed by two large bodies of geoscience evidence for (A) large amounts of nuclear decay having occurred, and (B) a young world. From the start, several members of the steering committee were convinced that episodes of greatly accelerated nuclear decay rates had occurred within thousands of years ago. For the preservation of life, such episodes seem possible only under special circumstances: (1) before God created living things, (2) after the Fall but well beneath the biosphere, and (3) during the year of the Genesis Flood, when the occupants of Noah's ark would be safe from most radiation (Humphreys, 2000, pp. 340–341). Accordingly, the steering committee planned a research program to test the accelerated decay hypothesis, and they wrote a book (jointly published by ICR and CRS) outlining the various projects (Vardiman et al., 2000).

In developing our plans for the helium experiments, we calculated what diffusion rates would be necessary to produce Gentry's reported helium retentions if the zircons were (a) 6,000 years old, or (b) 1.5 billion years old. Figure 4 shows the graph we published (Humphreys, 2000, p. 348, Figure 7) of the resulting two models.

Figure 4, the prediction, is a typical *Arrhenius* plot. The vertical axis shows *diffusivities* (giving rates of diffusion) logarithmically. The horizontal axis shows inverse absolute temperature (1000 divided by degrees Kelvin) linearly. High temperatures are on the left and low temperatures are on the right. Diffusion data on such a plot usually fall into one or two straight lines (Humphreys et al., 2003a, § 3). Notice that the diffusion rates in the Uniformitarian model are over 100,000 times slower (to retain helium 1.5 billion years) than those in the Creation model (6,000 years). Such a large difference made it likely that experiments would be able to distinguish between the two models, so we began seeking ways to conduct or commission such measurements.

Experiments begin

In 2000, through an intermediary, we contracted with a well recognized expert (Humphreys et al., 2003a, § 5) to

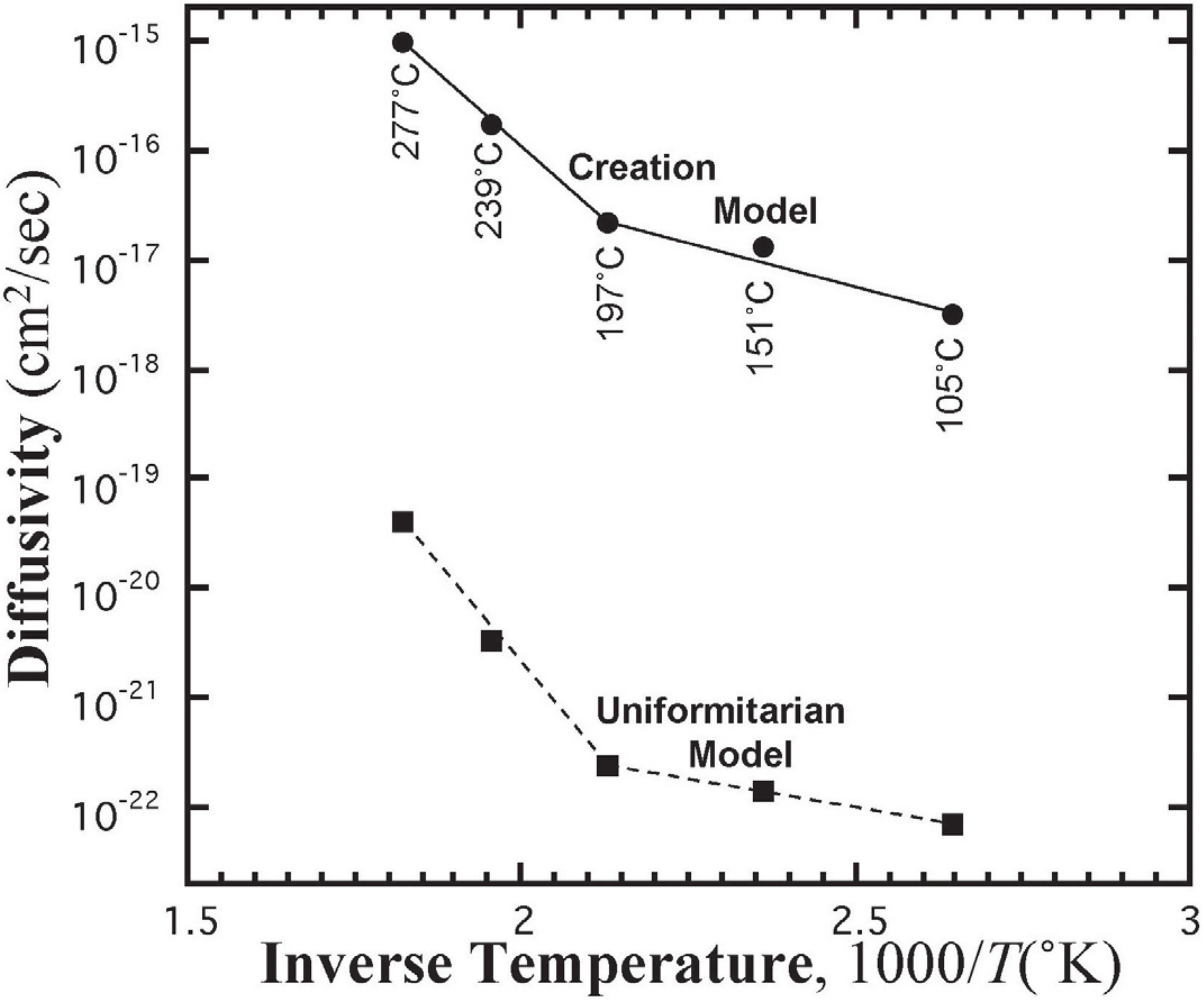

Figure 4. Predicted (Humphreys, 2000, p. 348, Figure 7) helium diffusion rates necessary to retain the observed amounts of helium (Table I) for (a) 6,000 years (Creation model), or (b) 1.5 billion years (Uniformitarian model).

measure helium diffusion rates in biotite, the mineral we thought was the main restriction to helium loss from the zircons. We sent the experimenter biotite we had on hand, from the Beartooth Gneiss in Wyoming near Yellowstone National Park. In early 2001 he sent us data, the first ever reported on biotite. Also in 2001, we received a preprint of a paper reporting helium diffusion rates measured in zircons from Nevada (Reiners et al., 2002).

These data quickly showed us that the zircon itself, not the surrounding biotite, was the main restriction to helium outflow. But we found that when we modified the theoretical model accordingly (see appendix of this paper, page 14, discussion on change 5), the diffusivities in our prediction changed by less than 0.5 percent (Humphreys et al., 2003a, § 6). So the numbers of the prediction in Figure 4 are valid, but they should be applied to zircon, not biotite.

The Nevada zircon data agreed encouragingly with our prediction, but did not extend to low enough temperatures to overlap it. Moreover, those zircons were not from the New Mexico site. Neither were the biotites. Because helium diffusion in minerals can vary significantly from site to site, we decided to get data on biotites and zircons from the same borehole, GT-2, from which Gentry's zircons came. Los Alamos National Laboratory kindly gave us several GT-2 core samples from a depth of 750 meters. That is somewhat shallower than Gentry's samples, but still in the same rock unit. We sent one of them to Activation Laboratories in Ontario, Canada, where Jakov Kapusta extracted the biotite and zircons. He did not separate the zircons into size groups. He measured the uranium and lead isotopes in three of the zircons, finding a ^{206}Pb/^{207}Pb age of 1439 ± 2 million years (Humphreys et al., 2003a, Appendix A). That is within a few percent of the published age for zircons deeper in the borehole (this paper, page 1).

Then we sent both the biotite and the zircons to our experimenter. He sieved the biotite sample to get flakes between 75 and 100 µm, but he used all the zircons Kapusta extracted, regardless of size. Size of crystals (*effective radius*) is important in converting the raw data into diffusivities. He sent us the raw data in 2002.

As before, in the temperature range of interest to us, the biotite diffusivities were about one order of magnitude greater than those of zircon. That confirmed that the zircon rates were more important. Those data lined up well with the prediction, but again did not extend to low enough temperatures to overlap it (Humphreys et al., 2003a, § 8, Figure 8).

After that, in the summer and fall of 2002, we tried several times to get lower-temperature data. However, we only discovered several wrong ways to make such measurements. First, we asked the experimenter to do new runs on the same batch of zircons, but at lower temperatures. The results were ambiguous, an effect we decided was due to exhaustion of helium from the smaller zircons in the batch (Fechtig and Kalbitzer, 1966, § 2.5, p. 72).

Second, we sent the experimenter a new set of zircons from the same depth in GT-2 and asked him to sieve out crystals in the 50–75 µm size range. Before sieving, he decided to leach the crystals in cold concentrated hydrofluoric acid (HF) to remove flecks of biotite clinging to them. Though the technique was new, it seemed reasonable. However, the values of D/a^2 he then obtained were over fifty times higher than all previous zircon data, both ours and published. Scanning electron microscope images done later (see next section) revealed severe pitting and cracking in the HF-treated zircons. That would allow helium to leave the zircons much faster than normally.

These were all the data we had by February 2003, the deadline for the final version of our conference paper (Humphreys et al., 2003a).

Latest results arrive in mid-2003

In the fall of 2002, we acquired new samples from borehole GT-2, this time from a depth of 1490 meters. That is between the depths of Gentry's samples 1 and 2 (see Table I). We sent them to Activation Laboratories, where Kapusta extracted both biotites and zircons. This time he sorted the zircons into several size groups, getting about 1200 crystals in the size range Gentry used, having lengths of 50–75 µm.

Figure 5 shows a scanning electron microscope (SEM) image of one such zircon. Mark Armitage obtained the image in his newly established microscopy laboratory at ICR, where he also obtained SEM images of the HF-treated zircons the previous section mentioned. In the spring of 2003, we sent our experimenter the 50–75 µm zircons, along with the biotites. This time we asked him (a) not to etch the crystals in HF (unnecessary because no sieving was needed) and (b) to get zircon diffusivities at lower temperatures. We also asked that he measure more precisely the total helium per unit mass in both the zircons and the biotites. In July 2003, one month before the conference, we received his results.

As usual, the experimenter measured the rate of helium release at various steps of temperature. Then he placed that data into standard formulas to calculate D/a^2, where D is the diffusivity and a is the effective radius of the crystals. Column 6 of Table II shows the resulting values of

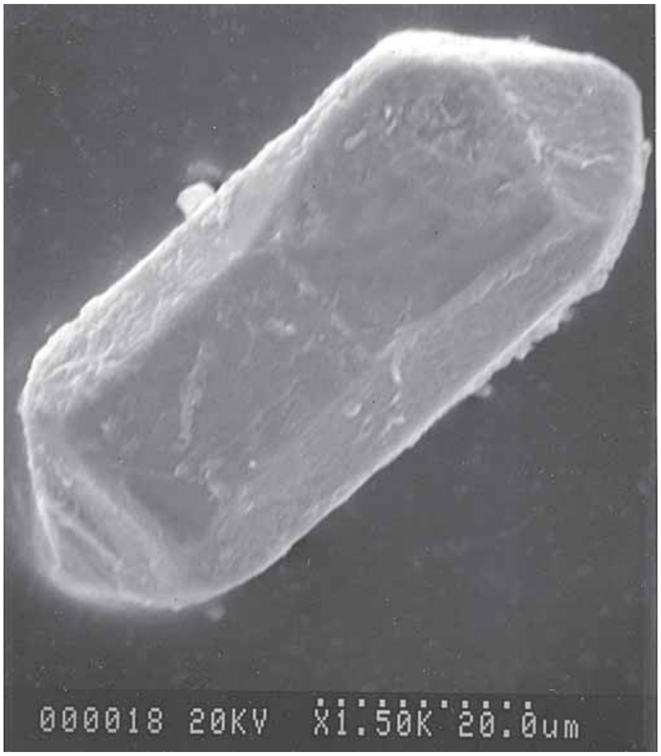

Figure 5. Scanning electron microscopy photograph by Mark Armitage of zircon from group selected by size by Jakov Kapusta.

Step	Temp. (˚C)	He (ncc)	Time (sec)	Cum. Fract.	D/a^2 ($\mathrm{sec^{-1}}$)	D ($\mathrm{cm^2/sec}$)
1	50	1.91E-05	3660	1.41E-08	4.73E-21	
2	100	3.82E-03	3660	2.83E-06	1.91E-16	
4	200	3.17E-01	3600	0.000256	1.58E-12	
5	250	1.32E-01	3660	0.000354	1.41E-12	
6	300	3.43E-01	3660	0.000606	5.78E-12	
7	350	2.97E+00	3660	0.002798	1.78E-10	
8	400	9.86E+00	3600	0.010072	2.27E-09	
9	450	4.28E+01	3660	0.041626	3.89E-08	
10	500	1.48E+02	3600	0.150546	5.55E-07	4.99E-12
11	475	3.93E+01	3660	0.179567	2.63E-07	2.37E-12
12	425	4.90E+00	3600	0.183185	3.72E-08	3.35E-13
13	375	6.29E-01	3660	0.183649	4.75E-09	4.28E-14
14	325	7.77E-02	3600	0.183706	5.98E-10	5.38E-15
15	275	1.01E-02	3660	0.183714	7.64E-11	6.88E-16
16	225	3.56E-03	7260	0.183716	1.36E-11	1.22E-16
17	175	7.78E-04	7260	0.183717	2.97E-12	2.68E-17
18	205	2.03E-03	7200	0.183718	7.81E-12	7.03E-17
19	255	4.25E-03	3660	0.183722	3.22E-11	2.90E-16
20	305	3.03E-02	3600	0.183744	2.33E-10	2.10E-15
21	355	2.41E-01	3660	0.183922	1.83E-09	1.65E-14
22	405	1.94E+00	3600	0.185352	1.50E-08	1.35E-13
23	455	1.47E+01	3600	0.196188	1.18E-07	1.06E-12
24	505	8.09E+01	3660	0.255886	7.87E-07	7.09E-12
25	460	1.35E+01	3660	0.265832	1.57E-07	1.41E-12
26	410	1.86E+00	3660	0.267207	2.23E-08	2.00E-13
27	360	2.46E-01	3600	0.267389	3.00E-09	2.70E-14
28	310	3.18E-02	3660	0.267412	3.82E-10	3.43E-15
Total helium yield: 1356 ncc at STP (includes fusion step). Mass: 216 µg						

Table II: Latest (2003) helium diffusion data for 50–75 µm length zircons from borehole GT-2 at a depth of 1490 meters. Column 3 is the amount of helium released (ncc defined in Table I) at the given temperature step. Column 4 is the time at each step. Column 5 is the cumulative fraction of the total helium yield (at bottom of table). Column 6 is the value of D/a^2 estimated by the experimenter according to standard formulas, where D is the diffusivity and a is the average effective radius. Column 7 is the value of D assuming a = 30 µm, and omitting steps 1–9 according to advice from the experimenter (see below).

D/a^2 for the zircons. The standard formulas (Fechtig and Kalbitzer, 1966, p. 71) assume that the initial distribution of helium in the zircons is uniform. But in reality, the zircons would have a "rounded" helium-versus-radius profile due to the *in situ* helium loss into the biotite. That is, less helium would emerge during the initial heating steps, because the outer regions of the zircon would be helium-depleted. In that case, said the devisers of the standard formulas (Fechtig and Kalbitzer, 1966, p. 71), "The apparent diffusion constants will come out too low, and the activation energies too high." In his report on the 2002 zircon runs (Humphreys et al., 2003, Appendix C), our experimenter advised us that to account for this effect, we should ignore the first set of increasing-temperature steps in his runs. For the 2003 zircons, he reported that we should treat them just the same. Accordingly, we ignored

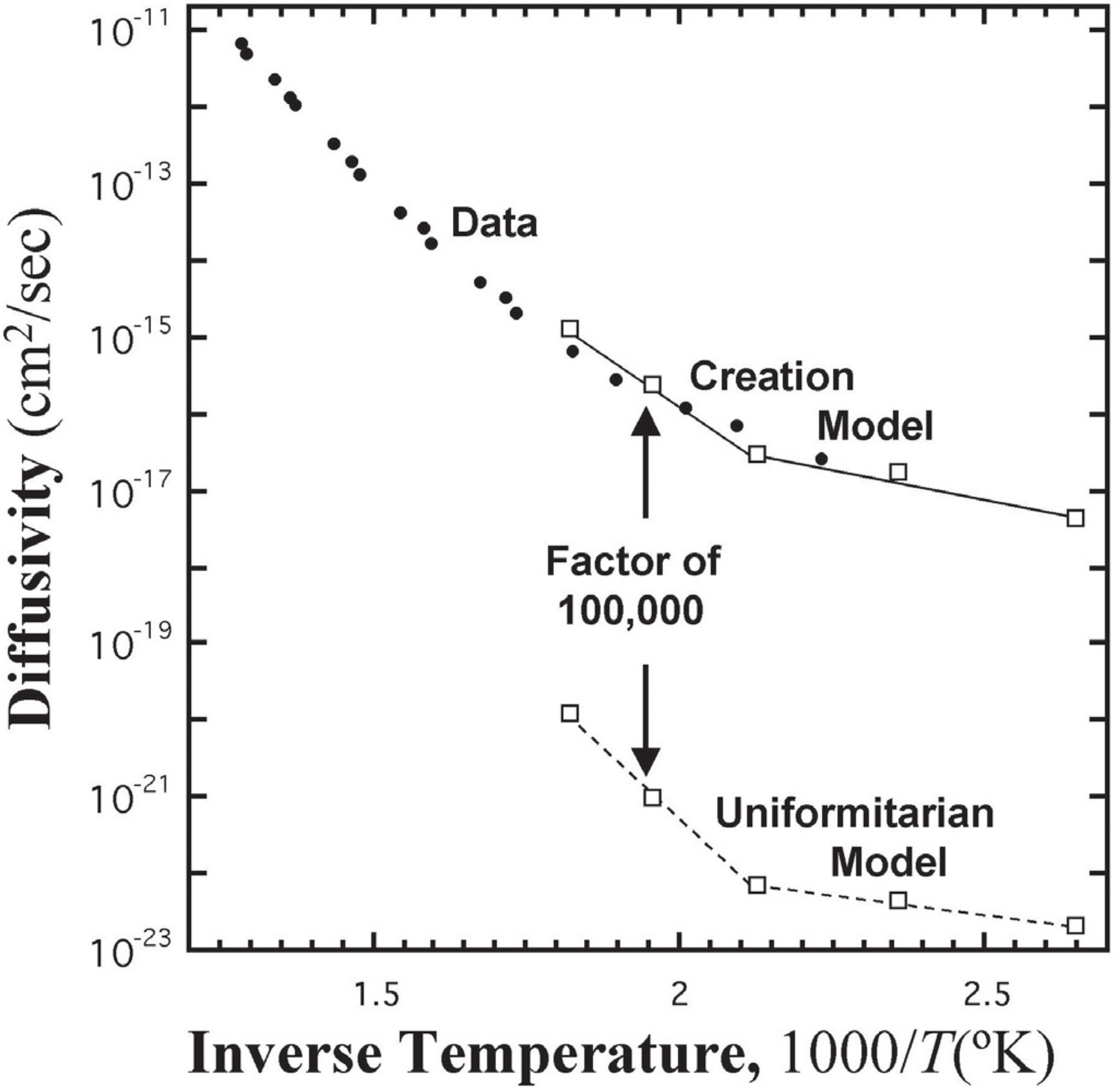

Figure 6. Recent (2003) zircon diffusion rate data compared with the Creation and Uniformitarian models shown in Figure 4.

steps 1–9 in calculating *D*. A more sophisticated analysis could probably extract accurate values of *D* from the raw helium-time data for those steps, but we leave that work for later research.

The effective radius *a* for zircons is about half their length (Humphreys et al., 2003a, § 6), which in this case gives us an average value for *a* of about 30 μm. Multiplying column 6 by the resulting value of a^2 gives us values of the diffusivity *D* for points 10-28, which we show in column 7 of Table II.

Figure 6 shows those values, plotted with the two models for comparison. The data agree with the predicted Creation model—as close as errors in the data and approximations in the model would lead us to expect. The data points extend past the "knee" of the model at 197° C, into the lower-temperature "defect" region determined by radiation damage in the crystals. This was quite important to examine, because the defect part of the curve can vary greatly from site to site (Humphreys et al., 2003a, §§ 3, 4). Even in the defect region, the data agree quite well with the model. It is not often in science that experimental data so clearly validate a pre-published numerical model!

The data also resoundingly reject the Uniformitarian model. The points of that model are the values of diffusivity required to retain the observed amounts of helium for 1.5 billion years at *today's* temperatures in the rock unit. However, uniformitarian thermal models of the rock unit require that the temperatures have been *higher* in the past (Kolstad and McGetchin, 1978; Harrison et al., 1986; Sakada, 1989). So the points of our Uniformitarian model are below the average temperatures during the alleged eons. A more accurate depiction would slide the Uniformitarian model points horizontally leftward to represent the allegedly higher average temperatures. That would make the vertical gap between that model and the data even larger (Humphreys et al., 2003b, see poster and extended temperature range Arrhenius plot at its bottom). Thus the Uniformitarian model in Figure 6 is very generous to uniformitarians, minimizing the gap. Even so, the data points are about 100,000 times higher than the model points. Uniformitarianism has totally failed this experimental test!

We can also compare the new diffusivities with the observed retentions to calculate the age of the zircons. Doing that point-by-point gives an average of 5,681 years with a sigma (square root of variance) of 1,999 years (Table III). We round that off to 6,000 ± 2,000 years.

Note carefully: Our diffusion dating method above differs entirely from the "helium dating" of (U-Th)/He chronometry (Reiners, 2002). Very crudely, the difference is this: (U-Th)/He chronometry divides the number of helium atoms *in* a crystal by *nuclear* decay rate. Diffusion dating divides the number of helium atoms *lost* from the crystal by the *diffusion* rate. It appears the practitioners of (U-Th)/He chronometry, in their unpublished comments upon this work, have not yet understood this basic distinction.

Recent data also close loopholes

After stepwise heating the 216 micrograms of zircons to get the diffusivity data, our experimenter raised the temperature to a high value, holding it there long enough to get the rest of the helium out of the crystals. The total yield of helium from the zircons was 1356 ncc (1 ncc = 10^{-9} cm^3 at standard temperature and pressure = 0.4462 x 10^{-4} nanomole), or 6.05 x 10^{-2} nmol. Dividing by the mass gives us 6.28 ncc/µg, or 303 nmol/g. Multiplying the latter value by the density of zircon,

Sample	Temp. (˚C)	Retention (%)	Diffusivity (cm²/s)	Age (years)
1	105	58	——	——
2	151	27	1.09×10^{-17}	7270
3	197	17	5.49×10^{-17}	2400
4	239	1.2	1.87×10^{-16}	5730
5	277	~0.1	7.97×10^{-16}	~7330
			Average:	5680
			Sigma:	1999

Table III: Estimates of age from Gentry's helium retentions (Table I) and our measurements of helium diffusivity in the same zircons (Table II). Diffusivities here come from best exponential fits to nearby measured points from Table II, column 7. Because our lowest measured value for *D* is at 175° C, we extrapolated 24° C down to the temperature of sample 2 but not 45° C further down to that of sample 1. Then we calculated ages as we did in our *ICC03* paper (Humphreys et al., 2003a, §§ 6 and 8), putting the *x*-values of *ICC03* Table 2 and the values of *D* above into *ICC03* equation 17 to get the values for the age *t* we show above. See our comments on page 9 (related to Figure 8) about sample 3, which above has the greatest deviation from the average age. We report the average and sigma above as 6,000 ± 2,000 years.

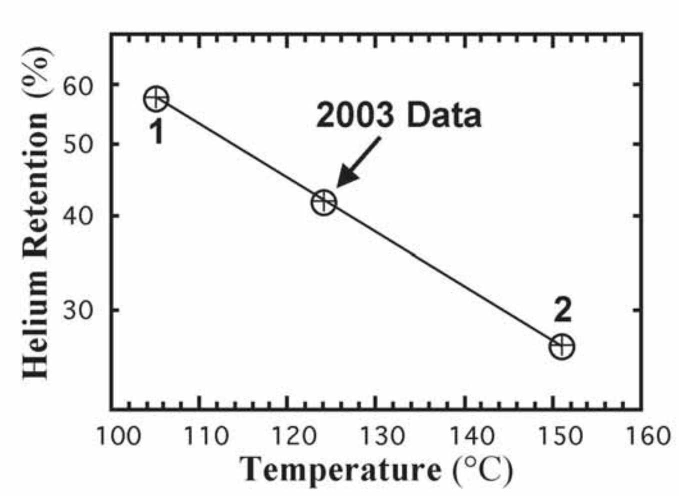

Figure 7. Recent (2003) measurement of percentage helium retained for zircons from 1490 meters depth and 124° C, compared with percent retentions (points 1 and 2) measured by Gentry et al. **(1982a) shown in Table I.**

4.7 g/cm³, gives us the helium concentration in the zircon: 1320 nmol/cm³.

For the 5.562 milligrams of biotite, the total yield of helium was 257 ncc, giving 2.06 nmol/g. Multiplying by the density of biotite, 3.2 grams/cm³, gives us the helium concentration in the biotite: 6.57 nmol/cm³.

These data are quite useful in closing possible loopholes in our case. First, the 6.3 ncc/μg yield of these zircons is quite consistent with Gentry's retention data. Using Gentry's estimate of radiogenic helium deposited in the zircons, about 15 ncc/μg (which is consistent with our data on radiogenic lead in the zircons), gives us a retention fraction of 0.42 (42%). These zircons came from a depth of 1490 meters, nearly midway between Gentry's samples 1 and 2 in Table I. The interpolated temperature at that depth would be 124° C. Figure 7 shows that our new retention point fits quite well between Gentry's retentions for samples 1 and 2. This confirms the validity of Gentry's retention measurements.

Second, the concentration of helium in the zircon, 1320 nmol/cm³, is about 200 times greater than the concentration in the surrounding biotite, 6.6 nmol/cm³. Because the laws of diffusion require flow from greater to lesser concentrations, these data mean that helium is moving *from* the zircons *into* the biotite, not the other way around.

Third, because the average volume of the biotite flakes is hundreds of times greater than that of the zircons (Humphreys et al., 2003a, § 6), the amount of helium in the biotites is on the same order of magnitude as the amount of helium lost by the zircons. That rebuts a specious uniformitarian conjecture (Ross, 2003) that there could have been vast amounts (100,000 times greater than the already-large observed amounts) of non-radiogenic primordial helium in the zircons 1.5 billion years ago.

Our conference paper answers other commonly raised objections, including (1) a nearly automatic response among uniformitarians involving the geoscience concept of "closure temperature" (Humphreys et al., 2003a, § 10), and (2) the possibility that the rock unit was much cooler for most of its history. Two short answers are that (1) the closure temperature for these zircons happens to be relatively low, 128° C, permitting the zircons above that temperature to leak helium freely, and (2) the zircons would have to have been *refrigerated* cooler than *minus* 100° C in order to retain the helium for the alleged eons (Humphreys et al., 2003b, see poster and extended temperature range Arrhenius plot at its bottom). Our conference paper clarifies these points and adds other answers (Humphreys et al., 2003a, §§ 9, 10).

Our new helium retention fraction (0.42 at 124° C) can be treated the same way as we treated Gentry's retention data to make a prediction of diffusion rates. That is, we can use our retention figure to calculate what value of *D* at 124° C would be required if the zircons were 6,000 years old. Figure 8 shows how this "retrodiction" point fits very well with the diffusion rate data and the Creation model prediction.

In Figure 8, we have redrawn the lines in accord with the new data. The largest outlier from the lines is the model point at 197° C. The difference suggests the true retention fraction for that sample might have been about half the fraction Gentry et al. reported (Table 1, sample 3). Whatever the cause, a two-fold discrepancy for one point pales into insignificance in light of the whopping 100,000-fold discrepancy between the observed diffusivities and all points of the Uniformitarian model!

Lead diffusion supports our case

Lead also diffuses out of zircon, although much more slowly than helium does. In addition to studying helium, Gentry and his team (1982b) at Oak Ridge also studied lead retention in 50–75 μm zircons from the same rock unit. The deepest sample was from a depth of 4310 meters and a temperature of 313° C. The paper reports, "there was little or no differential Pb loss which can be attributed to the higher temperatures at greater depths." Judging from their experimental error, their results mean that more than 90% of the lead generated by "1.5 billion years" worth of nuclear decay has remained in even the deepest, hottest zircons.

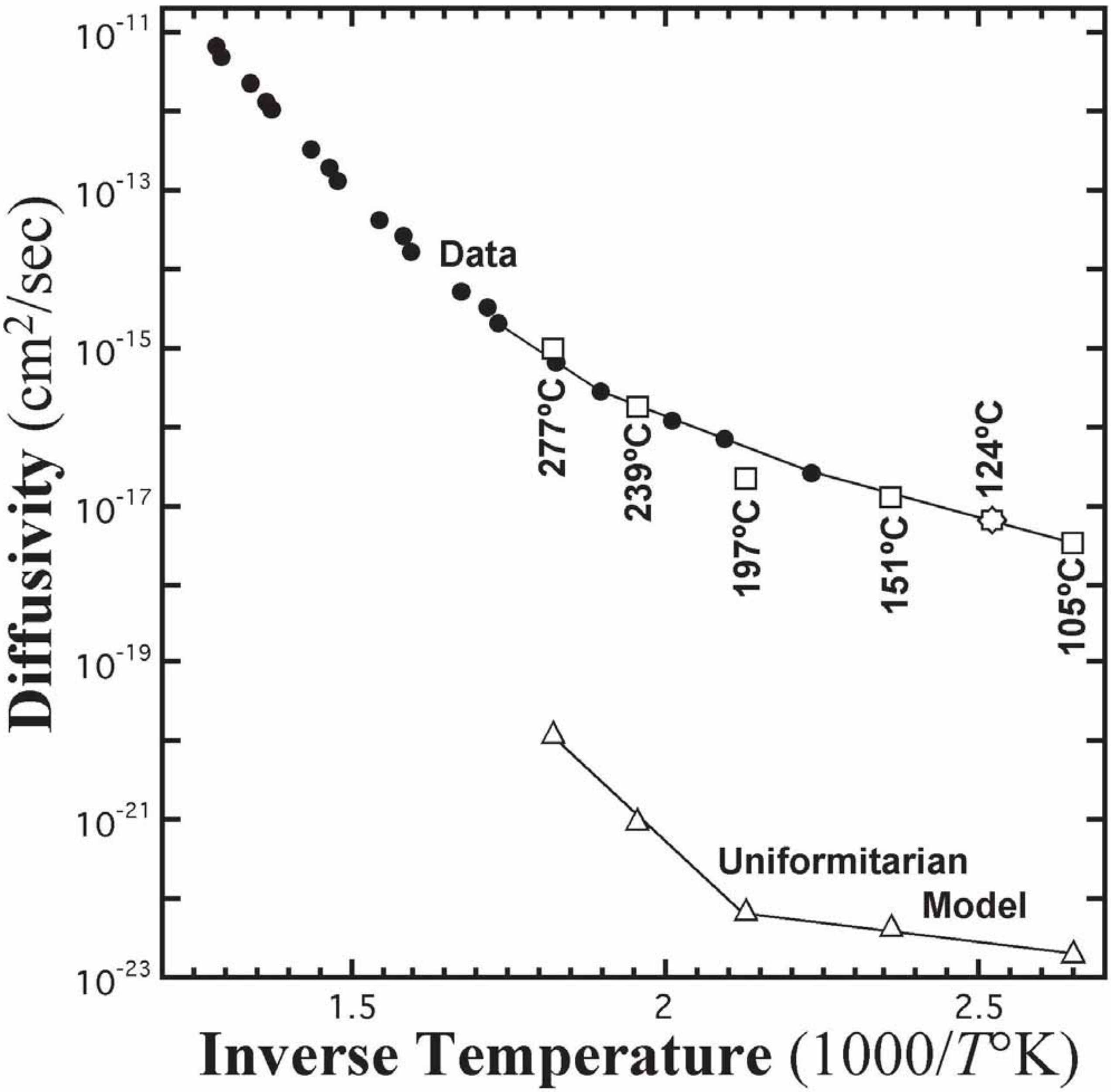

Figure 8. Figure 6 with lines redrawn in accordance with the new (2003) data. Squares with temperatures below them are the diffusivities we predicted in 2000 on the basis of Gentry's reported retentions (Table I, samples 1-5) and an age of 6,000 years. The star with "124° C" above it is the diffusivity required by our new retention datum (Table I, sample 2003, and page 9) and a 6,000-year age.

The diffusion rates for lead in zircon are known, and the article reports that at 200° C, it would take 50 billion years for 1% of the lead to diffuse out of a 50-μm zircon. However, the article does not report such times for higher temperatures. Using the same equation and data (Gentry et al., 1982b, note 16; Magomedov, 1970), we calculate that at the highest borehole temperature, 313° C, a zircon 60 μm long (a = 30 μm) would lose about 50% of its lead in 1.5 billion years. Because the observations show that those zircons did not lose anywhere near that much lead, these data imply an age much less than 1.5 billion years. Thus the lead diffusion data support the young helium diffusion age of the zircons.

Conclusion: a tale of two hourglasses

Experiments have strongly vindicated what creationists felt when Gentry reported the high helium retentions over twenty years ago. The helium indeed could not have remained in the zircons for even a million years, much less the alleged 1.5 billion years. Even more exciting, the most recent experiments give a helium diffusion age of 6,000 ± 2,000 years, which resonates strongly with the date of creation we get from a straightforward Biblical chronology.

Figure 9 illustrates the contrast between this helium age and the radioisotopic age. It shows two different "hourglasses," representing helium diffusion and uranium-to-lead nuclear decay. These hourglasses give drastically different dates.

We have much data to show that we have read the helium hourglass correctly: (1) Uranium-lead data give us the initial amount of sand (helium) in the top half (the zircon). (2) Gentry's measurements, confirmed by ours, give us the present amount of sand in the top half. (3) Our diffusion rate experiments show how fast sand is presently trickling (diffusing) out of the top half into the bottom half (the biotite). (4) Our measurements show roughly the right amount of sand in the bottom half (helium in the biotite). (5) A third hourglass representing lead diffusion, though crude, agrees with the helium result.

For the nuclear decay hourglass, we also know similar things: present amounts in the top half (uranium in the zircon), the present trickling rate (nuclear decay rates), and the amounts in the bottom half (lead isotopes in the zircon). The large amount of helium, the actual alpha particles from the decays, confirms that a large amount of nuclear decay has taken place.

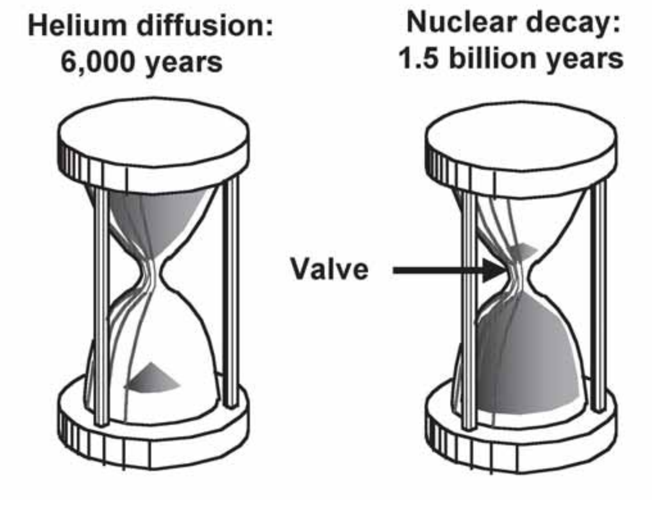

Figure 9. Two hourglasses representing dating by (a) helium diffusion and (b) uranium-lead decay. "Valve" represents possible nuclear decay acceleration.

One way to reconcile these two hourglass readings is to suggest that one of them has a "valve" at its bottleneck controlling the trickling rate, a valve that was adjusted drastically in the past, possibly by direct intervention from God.

Long-agers might want to imagine that the valve is on the helium hourglass, and that for billions of years, diffusion rates were over 100,000 times slower until a few thousand years ago. But diffusion rates are tied straightforwardly to the laws of atomic physics, which are in turn intimately connected to the biochemical processes that sustain life. It is difficult to imagine any such drastic difference in atomic physics that would have allowed life on earth to exist.

On the other hand, it is much simpler to imagine that the valve is on the nuclear decay hourglass. Nuclear forces affect only a tiny region at the center of the atom. They have very little effect on the electronic structure of the atom or its chemical interactions. Moreover, a relatively small change in nuclear forces can cause a billion-fold acceleration of nuclear decay rates (Chaffin, 2003; Chaffin, 2000; Humphreys, 2000). Finally, the preponderance of Biblical and geoscience evidence for a young world (Humphreys, 2000, pp. 337–339) points to a change that would only affect dating methods which depend on slowly-decaying nuclei.

Thus our new diffusion data support the main hypothesis of the RATE research initiative: that God drastically accelerated the decay rates of long half-life nuclei during the earth's recent past. For a feasibility study of this hypothesis—including God's possible purposes for such acceleration, Biblical passages hinting at it, disposal of excess heat, preserving life on earth, and effects on stars—see Humphreys (2000, pp. 333–379). The last three problems are not yet fully solved, but we expect to see progress on them in future papers.

Other RATE projects (Vardiman et al., 2003) are providing other very exciting evidence supporting the hypothesis, such as precision radioisotope measurements (Snelling, et al., 2003a), carbon 14 in fossils and diamonds (Baumgardner et al., 2003a, 2003b), nuclear theory (Chaffin, 2003), and new radiohalo evidence (Snelling and Armitage, 2003; Snelling et al., 2003b). After submitting this paper for publication, we presented these new results in a poster and an abstract at the American Geophysical Union Annual Fall Meeting in San Francisco in December 2003 (Humphreys et al., 2003b). We also presented results from two other RATE projects there (Baumgardner et al., 2003b; Snelling et al. 2003b). RATE hopes to release both a final technical report and a layman's book (authored by Don DeYoung) in the fall of 2005. These are exhilarating days for creation science!

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Appendix: Responding to a Critic

Recently a critic sought very hard to find loopholes in our arguments. While none of his points had any significant impact on our conclusions, it is worthwhile to review the specifics of his critique and answer them here. The critic felt a crucial issue was the possibility that the interface between zircon and biotite might slow or stop helium diffusion because of helium having different *chemical potentials* or *solubilities* in those two minerals, or because of *interface resistance* between them due to other causes. In the next three sections we will explain those terms and quantify their effects.

Differences in chemical potential

A diffusion theorist (Manning, 1968, § 5-3, p. 180, equation 5-36) expresses the *chemical potential*, μ, for helium atoms constituting a fraction N of all the atoms in a crystal at temperature T as the sum of two parts:

$$\mu = kT\ln N + \mu' \tag{A1}$$

where k is the Boltzmann constant. The first term on the right, the "entropy of mixing," contains no information related to the forces between atoms. The second term, μ', is of interest. It is the contribution from all other factors, particularly the interaction energy between helium and the other atoms of the crystal.

The same theorist (Manning, 1968, § 5-3, p. 180, equations 5-37 and 5-39) then expresses the flux J of helium atoms in the x-direction through a region with diffusivity D as:

$$J = -D\frac{\partial C}{\partial x} - \frac{DC}{kT}\frac{\partial \mu'}{\partial x} \tag{A2}$$

The first term on the right represents ordinary diffusion. It is the second term that represents an additional flux due to a driving force, the gradient of μ'. This force originates in whatever chemical attraction the helium atom might have for the atoms of the crystal in which it resides. Inside the crystal, these forces average to zero, but at the interface with another crystal, there may be a jump in μ'. If a helium atom were to have greater chemical attraction for the atoms of zircon than for the atoms of biotite, that would result in a force at the interface hindering its outward motion into the biotite. The question we need to address is, "Just how great is the effect?"

Because helium is one of the noble gases, we might suspect that it would have very little chemical attraction for any other atoms. In fact, helium is the least chemically active of all the noble gases (Holloway, 1968, p. 45, Table 2.1). Nevertheless it does exhibit a faint attraction for other atoms. Theory and experiments (Wilson et al., p. 936, Table XI) show that helium atoms adhere very slightly to the surfaces of alkali halide crystals, with interaction potentials on the order of a few hundred calories per mole of helium. The largest estimated potential is 293.4 cal/mol, at the "saddle point" between the sodium and fluorine ions at the surface of NaF. The smallest potential listed is beside a chlorine ion at the surface of NaCl, 111.7 cal/mol.

The difference of those potentials provides an estimate of the difference of μ' at an interface between NaF and NaCl: 181.7 cal/mol, or 0.00788 eV per helium atom. Because noble gases have a greater chemical affinity for halides (Holloway, 1968, p. 89) than for most other ions, the above number is almost certainly greater than the corresponding number for the silicate minerals we are considering. So at the interface between zircon and biotite, we can take the following value as a generous upper bound on the magnitude (absolute value) of the difference in μ':

$$\left|\Delta\mu'\right| < 0.0079 \text{ eV/atom} \tag{A3}$$

Now we need to quantify the effect of that difference on the flux of helium atoms in equation A2. As we did in our ICC paper (Humphreys et al., 2003a, § 6, after equation 9), we assume for simplicity that the diffusivity D is the same for biotite as for zircon, and therefore constant across the interface. Because the observed value of C in the biotite is hundreds of times smaller than in the zircon (this paper, § 5), the magnitude of the change in concentration, ΔC, across the interface is nearly equal to the concentration C in the zircon:

$$\left|\Delta C\right| \approx C \tag{A4}$$

Assuming that the changes ΔC and $\Delta\mu'$ both occur within roughly the same small distance δx, the width of the interface, the helium flux J in equation (A2) becomes:

$$J \approx -D\frac{\Delta C}{\delta x} - D\frac{\Delta C}{\delta x}\frac{\Delta\mu'}{kT} \tag{A5}$$

To make this mechanism a viable possibility for rescuing the uniformitarian scenario, the second term on the right-hand side must be: (1) of opposite sign to the first

($\Delta\mu'$ must be negative, meaning helium is more attracted to zircon than biotite), and (2) large enough to reduce J to a level about 100,000 times lower than what the first term alone would give. That could reduce the helium flow enough to let the zircon retain the helium for 1.5 billion years. In the coolest sample we analyzed, at 100° C, the average thermal energy kT of the atoms was 0.0321 eV. Then $|\Delta\mu'/kT|$ would be less than 0.246 for that sample, and even smaller for the hotter samples. That makes the magnitude of the second term less than 25% of that of the first term for all the samples we analyzed. However, our upper bound on the value of $\Delta\mu'$ based on the chemical affinity of helium with alkali halides is likely at least an order of magnitude larger than the actual value. So a magnitude of the second term less than 2.5% of the first term is probably more realistic. The second term obviously does not provide the large reduction of helium flow the uniformitarian scenario requires.

However, an even more basic consideration shows our measurement procedures have already accounted for such differences. We note that the magnitude of $\Delta\mu'$ is several times greater for a zircon-vacuum interface than for a zircon-biotite interface. That is, the attraction of a helium atom for the biotite it is entering partly cancels its attraction for the zircon it is leaving. But our experimenter measured the diffusivities of zircons in a *vacuum*. So the zircon diffusivities we report in Table II already include the effect of a *stronger* interface reflection than would exist for the zircons in their natural biotite setting. So however strong or weak the "chemical potential" interface effect may be, our measured diffusivities already account for it in a way that is generous to the uniformitarian model.

Solubility

Solubility in this context corresponds to the maximum number of helium atoms one gram of crystal can absorb per bar of pressure (Weast, 1986, p. 101). The critic used the term as a measure of the difficulty with which a helium atom could enter biotite. As a hypothetical example, if all the spaces between atoms in biotite were much smaller than the diameter of a helium atom, then helium could never enter the crystal, so helium would be completely insoluble in biotite. If an alpha-decaying nucleus inside the biotite were to generate a helium atom therein, then the atom could distort the lattice and push its way out. The crystal would have a small but non-zero helium diffusivity and zero solubility.

However, real minerals have non-zero solubilities. The solubilities of helium in obsidian and basaltic glass between 200 and 300° C, for example, are on the order of 50 nmol/g per bar (Jambon and Shelby, 1980, Fig 2c) and on the same order in other minerals (Broadhurst et al., 1992). The solubility of helium in biotite has not been measured (we were the first to measure even diffusivity for that pair of substances), so we must find a way to estimate its effect in this case.

One way is to consider the interaction potential part μ' of the chemical potential we mentioned in the previous section. For a helium atom near the surface of a crystal, the gradient of the potential is negative, making the force attractive. But the force can become repulsive for a helium atom entering a tightly packed crystal. For example, imagine that a helium atom has to come very close to an oxygen atom. If their nuclei are closer together than 2.94 Å (1 Å = 1 angstrom = 1×10^{-8} cm ≈ diameter of a neutral hydrogen atom), the force between the two atoms is repulsive (Kar and Chakravarty, 2001, Table I σ_{os} column and gradient of their equation 2).

However the space between silicate sheets in biotite is much larger than that (Deer et al., 1962, Vol. 3, pp. 1–3, 55; Dahl, 1996, Figure 1 and Table 4). The large spacing is the reason the diffusivity of helium in biotite (Humphreys et al., 2003a, Figure 6b) is about ten times higher than in zircon, which has tighter spacing (Deer et al., 1962, Vol. I, pp. 59–68). The relative spacings and diffusivities imply the solubility of helium in biotite is greater than in zircon, so the force related to solubility, included in the gradient of μ', would tend to push helium atoms out of zircon and into biotite. Hence their respective solubilities would not hinder helium outflow from the zircon but rather enhance it.

Interface resistance

Our critic also postulated some type of *interface resistance* arising from special distortion of the crystalline lattices at the interface between zircon and biotite. We can model such hypothetical interface resistance (Crank, 1975, p. 40, § 3.4.1) as a very thin layer of very low diffusivity between the zircon and biotite. The concentration of helium would drop rapidly across the layer, approximating a discontinuous change of concentration between zircon and biotite. Such a layer might consist of physically or chemically altered zircon or biotite, and it would be at most a few dozen angstroms thick.

Let us estimate how low the diffusivity D of the interface would have to be in order to retain the helium in the zircon for 1.5 billion years. Since D is supposed to be much lower than the diffusivities of both zircon and biotite, we can approximate the situation as a hollow sphere with a wall of diffusivity D having an inner radius a and outer radius b. A source (representing nuclear decay) inside the sphere generates helium at a steady rate q_0, and the helium diffuses through the wall out into a vacuum outside the sphere. Textbooks show (Carslaw and Jaeger, 1959, §9.2, p. 231, example IV, $Q_0 \rightarrow q_0$, $K \rightarrow D$, $v_1 \rightarrow C$, $v_2 \rightarrow 0$) that the steady-state helium outflow q_0 is

$$q_0 = 4\pi D C \frac{ab}{b-a} \tag{A6}$$

where C is the steady-state concentration of helium inside the sphere. Taking the wall thickness δ ($b = a + \delta$) to be small compared to a ($\delta << a$), integrating q_0 for time t, and C over the sphere volume (Humphreys et al., 2003a, § 7, equation 16) gives us the ratio of helium retained, Q, to total helium generated, Q_0:

$$\frac{Q}{Q_0} \approx \frac{a\delta}{3Dt} \tag{A7}$$

Turning this around gives us the interface diffusivity D required to retain a fraction Q/Q_0 of helium for time t in a zircon of effective radius a surrounded by an interface of thickness δ:

$$D \approx \frac{a\delta}{3(Q/Q_0)t} \tag{A8}$$

For example, with an interface thickness of 30 angstroms, $a = 30$ μm, and a time of 1.5 billion years, the 17% retention of sample 3 requires an interface diffusivity of

$$D \approx 3.8 \times 10^{-26} \text{ cm}^2/\text{second} \tag{A9}$$

This is over *ten billion times lower* than the diffusivities we measured in biotite (Humphreys et al., 2003, Figure 6b) and zircon (this paper, Figure 8) at the same temperature, 197° C. To see whether this is an achievable value or not, let us examine an example the critic gave for physical alteration of the minerals at the zircon-biotite interface.

The critic suggested that when biotite crystallizes around a zircon, it possibly forms with its silicate sheets (along which are the cleavage planes) everywhere parallel to the surface of the zircon, so that the biotite wraps up the zircon like layers of cellophane. But in the thousands of zircon-containing biotite flakes that we ourselves have observed under the microscope (Snelling and Armitage, 2003; Snelling et al., 2003b), the silicate sheets remain parallel all the way to the edge of the zircon crystal and do not wrap around the included zircons. A Los Alamos report has a photo of a radiohalo in biotite from borehole GT-2 showing the biotite cleavage staying parallel to itself, running right up against the zircon, and not becoming parallel to the zircon surface (Laughlin and Eddy, 1977, Figure 6, p. 18). There is simply no observational support for the critic's hypothesis that layers of biotite envelop an included zircon.

However, for the sake of having a specific illustration of interface resistance, let us indulge the critic and imagine that a few of the biotite layers closest to the zircon wrap around it. We will even imagine that there are no openings in the biotite wrapping at the edges and corners of the zircon faces. In that case, diffusion in the interface would have to take place in the harder direction, perpendicular to the silicate sheets rather than parallel to them.

Let us estimate the diffusivity in that harder direction. Measurements show that in biotite, "Ar diffusion is ~500 times faster parallel to the silicate sheets than perpendicular to the silicate sheets" (Onstott et al., 1991, § 7, p. 166). Because a helium atom has a smaller diameter, 2.28 Å, than an argon atom, 3.35 Å (Kar and Chakravarty, 2001, Table I σ_{ss} column), then for helium there should not be as great a difference between "parallel" diffusivity $D_{||}$ and "perpendicular" diffusivity $D_\perp$. So for helium in biotite, the ratio $D_{||} / D_\perp$ should be less than 500. Our measurements for helium in biotite (Humphreys et al, 2003, Figure 6b) gave, for example, $D_{||} = 8.6 \times 10^{-15}$ cm²/s at 200° C. Dividing that diffusivity by 500 gives us a lower bound on the diffusivity in the difficult direction:

$$D_\perp > 1.7 \times 10^{-17} \text{ cm}^2/\text{second} \tag{A10}$$

That is over *400 million times greater* than the maximum diffusivity, equation (A9), that a 30 Å interface could have to retain the helium for 1.5 Gyr. Hence such a hypothetical mechanism fails to account for the high helium retention we document. Moreover, as we have already indicated, there is no observational support for the sort of interface crystallographic structure our critic speculates might exist.

Effects of model assumptions

The critic also explored the effects of several changes in the assumptions of our models: (1) inserting a large interface resistance, (2) greatly increasing the creation model D for biotite, (3) decreasing the uniformitarian model D for biotite from infinity to that of zircon, (4) accounting for anisotropy of biotite and zircon, and (5) changing the effective radius a from our early value of 22 μm (Humphreys, 2000, p. 347) to our more recent and more appropriate value of 30 μm (Humphreys et al., 2003a, § 6, after equation 9).

We have discussed change (1) in the preceding section, showing that it is unrealistic. Change (2) increases the helium loss rate from the zircons by a factor of six, making it less realistic than our assumption, which had a worst-case effect of 30% (Humphreys et al., 2003a, § 6, after equation 9). Change (3) decreases the loss rate from zircons by a factor of six, but we think it is unrealistic for uniformitarians to demand an extremely low value of D for the biotite as well as the zircon.

Regarding mineral anisotropies (4), we point out two things: (a) switching from sphere to cylinder geometry (roughly approximating anisotropy effects) for the most important mineral (zircon) would alter the results by less than a factor of two, and (b) even a factor-of-ten reduction in the modeled diffusivity of the surrounding mineral (biotite) would change our results by less than 30% (Humphreys et al., 2003a, § 6 after equation 9). Thus, accounting for biotite anisotropy would affect our results by much less than 30%. As for zircon, anisotropy in it is probably just as negligible as it is in many other similarly shaped crystals, such as quartz. Both our experimenter and other diffusion experts have not assigned a high priority to investigating that possibility.

Change (5), the increase in effective radius a required by our better knowledge of zircons, by itself would have increased the model-required D's by a factor of about two. But our better knowledge also required another model change, from a "bubble" in biotite to a solid in biotite. This second change reduced the D's by about a factor of two. Because the two effects nearly cancelled each other out, the *net* change in predicted D was less than 0.5%. We explained these things in our ICC paper (Humphreys et al., 2003a, § 6), but perhaps not clearly enough.

The critic acknowledged that changes (2-5) would not come anywhere close to eliminating the 100,000-fold discrepancy between our data and any reasonable uniformitarian scenario. But he asserted that the several-fold sensitivity to changes in assumptions means that the close agreement between the creation model and the data was merely accidental. That may be a possibility, but it may also mean we exercised good theoretical judgment in choosing the simplifying assumptions for our prediction.

Closing criticisms

Finally, the critic proposed we postpone publication until (a) further theoretical and experimental investigations would close all alleged loopholes, and (b) until we have much more data supporting our case from boreholes all over the world. We disagree with him. On point (a), detractors can allege loopholes eternally, and we think we have addressed all the so-far-alleged loopholes well enough to place the burden of proof on the detractors.

On point (b), the critic was laboring under a misunderstanding. He reasoned that the possible scarcity of sites with what uniformitarians call "excess helium" meant that sites with high retentions and short helium *diffusion ages* are rare. As we explained at the ends of the introduction and the "Latest results arrive in mid-2003"section in this paper, those two concepts (excess helium and diffusion age) are fundamentally different. But even if he were correct, we feel that the data in this paper are so well established that immediate publication is warranted.

We thank Roger Lenard, a physicist at Sandia National Laboratories in Albuquerque, NM, for his expert advice on chemical thermodynamics, which helped us to prepare the "Solubility" and "Interface resistance" sections above.

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CRSQ: Creation Research Society Quarterly

ICC03: Proceedings of the Fifth International Conference on Creationism

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Jökullhlaups and Catastrophic Coal Formation

Carl R. Froede Jr.*

Abstract

Coal deposits within the Paraná Basin, Brazil apparently formed as a result of large-scale catastrophic deposition. The strata in the basin contain diamictites, turbidites, and coal layers exhibiting hummocky cross stratification, and are interpreted by uniformitarian geoscientists as having formed within a depositional setting analogous to catastrophic floods caused by one or more prehistoric jökullhlaups—an Icelandic term for glacial outburst. Naturalists speculate that extensive alpine glaciation created conditions where considerable volumes of water became trapped behind large glaciers. The catastrophic release of the water washed forests of spore-bearing plants into the basin's fluvial-deltaic glacial environment. This combination of sedimentary and organic material was buried by successive catastrophic event deposits and resulted in the creation of coaly siltstone deposits. Although uniformitarians must strain their paradigm to propose such a mechanism, their conclusions are predicted by the global Flood. These sedimentary deposits and associated coal layers formed during the Middle Flood Event Timeframe when tectonism and erosion created destabilizing conditions in areas that experienced uplift. The erosion and transport of material into the adjoining basin resulted in the formation of strata that reflect catastrophic Flood conditions.

Introduction

Uniformitarian geoscientists have many depositional models for coal-bearing strata. Interestingly, McCabe (1984) has reviewed several and found them unable to satisfactorily explain coal formation. I will not review that work here, but it is important to note that the various models of coal formation are typically not based on the specific coal layers, but rather on the overlying and underlying strata. The most popular model of coal formation came from the cyclothem concept which later developed into specific depositional paleoenvironments (Rahmani and Flores, 1984). Today, uniformitarians acknowledge that no one single depositional model adequately addresses all coal deposits.

In a recent article on high-energy deposits associated with coal layers in the Paraná Basin, Brazil, Begossi and Della Fávera (2002) proposed a setting comparable to the catastrophic floods that formed the Columbia River Valley Scablands. They suggested that these deposits could have formed due to jökullhlaups—an Icelandic term for catastrophic glacial outbursts which originate from the release of large volumes of stored melt water coming from nearby mountain glaciers (Begossi and Della Fávera, 2002). How do these deposits and the uniformitarian interpretation fit the Flood framework?

Paraná Basin, Brazil

The Paraná Basin is located in southern Brazil (Figure 1). It is believed by uniformitarian geologists to contain some of the thickest accumulations of glacially-influenced strata in the largest glaciated basin on the former Gondwana continent—covering approximately 618,000 mi^2 (França and Potter, 1991). As a result of extensive petroleum investigation starting in the late 1800s, a wealth of recorded subsurface data has been produced from this area (Eyles, Eyles, and França, 1993). The basin contains approximately 16,400 feet of Paleozoic and Mesozoic sedimentary fill covered by as much as 5,600 feet of Jurassic-Cretaceous flood basalt which is overlain in places by a thin mid-Cretaceous sandstone (França and Potter, 1991; Eyles, Eyles, and França, 1993)* [*Review França and Potter (1991) for additional information regarding sedimentary source areas, materials, and information on syntectonism in the Paraná Basin]. The flood basalt is believed to be one of the most voluminous and extensive flows of its type on Earth, covering as much as 95% of the basin (Eyles, Eyles, and França, 1993; França and Potter, 1991). The Itararé Group, along with the overlying Rio Bonito Formation (Late Carboniferous to Early Permian age—Figure 2), contains coal deposits interpreted to have been formed by one or more jökullhlaups.

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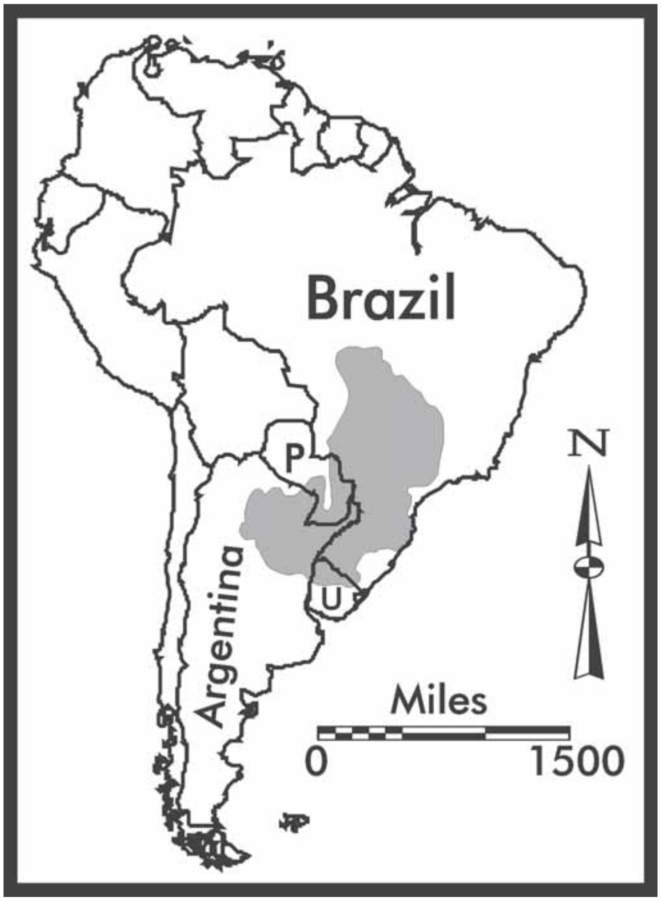
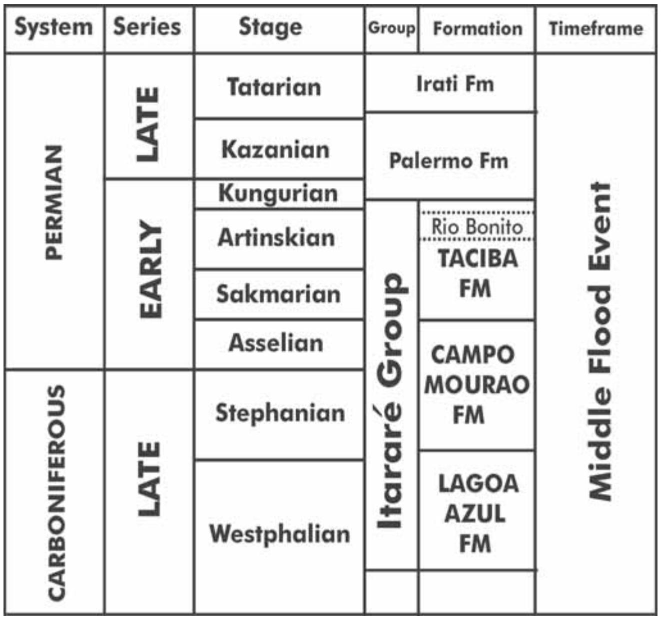


Figure 1. The Paraná Basin (shaded) occupies southern Brazil, and parts of Uruguay (U), Paraguay (P), and Argentina. Most of the exploration for hydrocarbon and coal has occurred in Brazil. Figure modified from França and Potter (1991), and Eyles, Eyles, and França (1993).



System	Series	Stage	Group	Formation	Timeframe
PERMIAN	LATE	Tatarian		Irati Fm	Middle Flood Event
		Kazanian		Palermo Fm	
	EARLY	Kungurian			
		Artinskian	Itararé Group	Rio Bonito TACIBA FM	
		Sakmarian			
		Asselian		CAMPO MOURAO FM	
CARBONIFEROUS	LATE	Stephanian			
		Westphalian		LAGOA AZUL FM	

Figure 2. Generalized stratigraphic column showing the position of the two primary coal-bearing units (i.e., the Rio Bonito Formation and the Itararé Group) found within the Paraná Basin in Brazil. Figure modified from França and Potter (1991), Begossi and Della Fávera (2002). Flood framework interpretation from Froede (1995; 1998). Beneath the Carboniferous coal deposits is a major unconformity (not illustrated) with what are interpreted by uniformitarian geoscientists as Ordovician glaciated deposits, Silurian sandstones, and Devonian shales (believed to be the primary source for hydrocarbons) [França and Potter, 1991; Eyles, Eyles, and França, 1993].

The silty-coal deposits found in the Paraná Basin are best understood as having occurred under catastrophic conditions, where materials were eroded from upland areas by gigantic floods, and transported and deposited in a marginal-marine fluvial-deltaic setting. Soon thereafter, destabilizing conditions must have occurred where the newly deposited clastics and organic materials were transported further offshore by turbidity currents. This is a dramatic departure from the standard uniformitarian model of a coastal swamp with occasional marine incursions resulting in the burial of organic layers later forming coal deposits (see McCabe, 1984).

The Rio Bonito Formation

The Rio Bonito Formation is lower Permian in age and lies within the western portion of the Paraná Basin (França and Potter, 1991). According to Begossi and Fávera (2002), coals from the Rio Bonito Formation are better identified as coaly siltstone than coal. Hummocky cross-stratified fine-grained sandstones and siltstones associated with coal layers in the Rio Bonito Formation provide sedimentary evidence of high-energy depositional conditions (Begossi and Fávera, 2002). They further state:

> The peculiar character, plus the overall occurrence of hummocky cross stratification (HCS) in the Rio Bonito Formation's coal... and close association with diamictites, suggesting lateral passages between these two lithological types, lead to an interpretation of deposition under high energy conditions... (Begossi and Fávera, 2002, p. 84)

The Itararé Group

The Itararé Group is the thickest unit in the Paraná Basin with up to 4,300 feet of sedimentary strata believed to have been catastrophically deposited over the course of 36 million years (Figure 3) [França and Potter, 1991]. According to Eyles, Eyles, and França (1993), the facies are interpreted to be the result of sedimentary gravity flows in a glacially-dominated marine basin. Sediments comprising this group can be subdivided into four types: diamictites, conglomerates, sandstones, and fine-grained deposits (Eyles, Eyles, and França, 1993). Interestingly, coal was not mentioned in the early studies of the sedimentary rock types examined from this group. This oversight is likely due to the extensive flood basalt cover and limited availability of outcrops.

The Recreio and Faxinal Mines, in Rio Grande do Sul State, Brazil

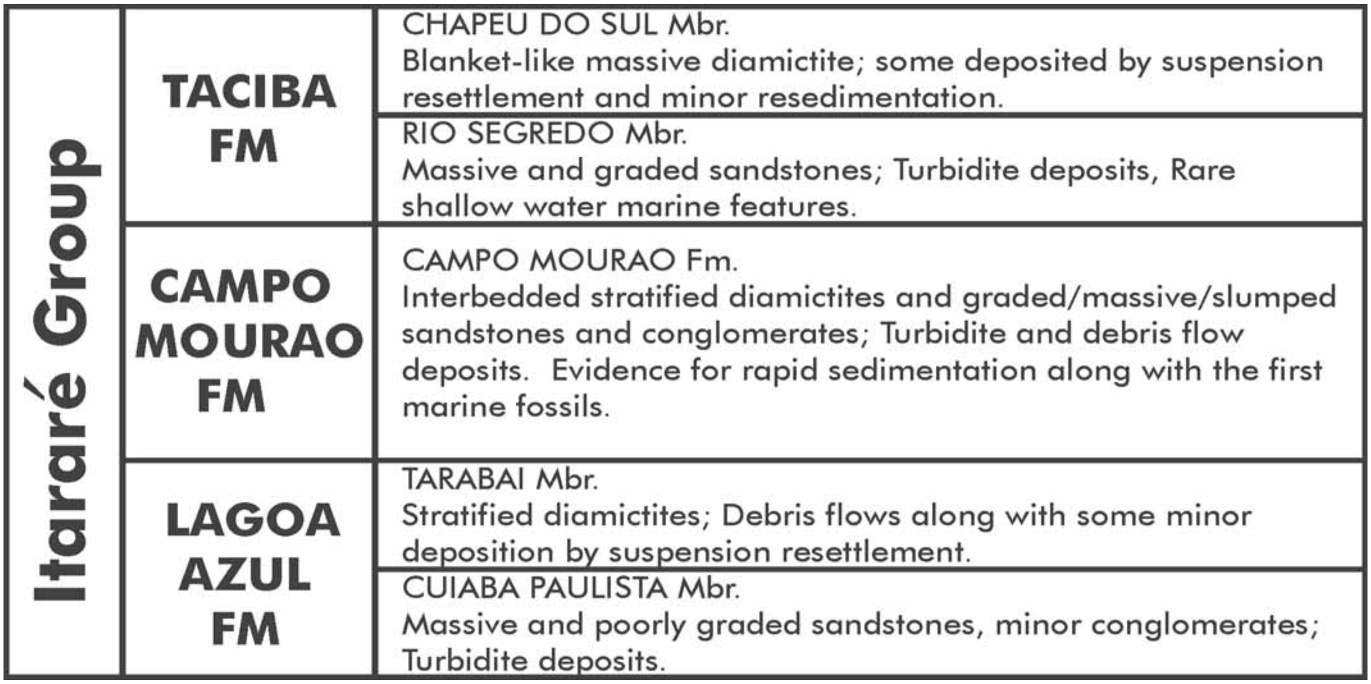
Begossi and Fávera (2002) focused their investigation on the sedimentary content of the Brazilian coal to the areas around two coal mines: Recreio and Faxinal. There they found high-energy sedimentary deposits (e.g., diamictites, hummocky cross stratification of fine-grain siliciclastics, and turbidites) in close association with the coal layers. The formation of these deposits requires a catastrophic interpretation. They state:

> Diamictites grade, laterally, to pebbly sandstones, indicating a flow transformation from debris-flow to high-density gravelly turbidity currents... Logs of trees, presumably taller than 30 m *(98 feet)*, appear to be floating in the diamictites, indicating that trees were plucked in catastrophic processes. Faceted and, possibly, striated clasts strongly suggest a glacial origin... (Begossi and Fávera, 2002, p. 87) [italics mine]

They conclude their investigation by stating:

> Catastrophic floods could be (sic) possibly be related to melting mountain glaciers, situated in the basin margins. These floods generated water and sediment admixtures with velocity and sediment concentration to produce hyperpicnal (sic) inflows and self-maintained turbidity currents. The resultant organic matter concentration in prodelta would be in the form of HCS coal layers (Begossi and Fávera, 2002, p. 89).

This catastrophic interpretation, placed within a glacial setting and entwined with uniformitarian assumptions, is an acceptable (though unusual) interpretation to most naturalists. However, it is important to notice the difference between what was observed and the uniformitarian



Itararé Group	TACIBA FM	CHAPEU DO SUL Mbr. Blanket-like massive diamictite; some deposited by suspension resettlement and minor resedimentation.
		RIO SEGREDO Mbr. Massive and graded sandstones; Turbidite deposits, Rare shallow water marine features.
	CAMPO MOURAO FM	CAMPO MOURAO Fm. Interbedded stratified diamictites and graded/massive/slumped sandstones and conglomerates; Turbidite and debris flow deposits. Evidence for rapid sedimentation along with the first marine fossils.
	LAGOA AZUL FM	TARABAI Mbr. Stratified diamictites; Debris flows along with some minor deposition by suspension resettlement.
		CUIABA PAULISTA Mbr. Massive and poorly graded sandstones, minor conglomerates; Turbidite deposits.

Figure 3. A generalized description of the stratigraphic units that compose the Itararé Group. The strata are interpreted by uniformitarian geoscientists to represent at least one if not two episodes of catastrophic glacial-marine deposition. However, if the naturalist interpretation is accepted, deposition would have been highly episodic with many millions of years of stasis between each depositional event. The Flood framework eliminates this unusual cycle of high and low (no?) energy by eliminating the excessive time (not reflected in the sediments) and is more consistent with the expectations of Occam's Razor. Figure modified from Eyles, Eyles, and França (1993) and França and Potter (1991).

interpretation. Although the data indicate a catastrophic setting, uniformitarian beliefs force the interpretation back to familiar ground.

Catastrophic Formation of Brazilian Coal Within A Young-Earth Flood Framework

Young-Earth creationists and naturalists observe the same physical features, but differ in conceptual frameworks. While naturalists assume history and science are the same, creationists use science as a forensic tool in the investigation of natural history. However, neither of these groups would disagree that the strata found in association with coal layers in both the Rio Bonito Formation and the underlying Itararé Group reflect a high-energy depositional setting. However, to equate diamictites with a prehistoric glacial paleoenvironment is an interpretative step not required by the data.

Several years ago, young-Earth creationist Michael Oard (1997) published an excellent monograph on the topic of prehistoric ice ages as interpreted by uniformitarian geoscientists. He showed how sedimentary features attributed to the so-called ancient ice ages could best be understood within the framework of the global Flood of Genesis. In a somewhat related effort, Howe and Froede (1999) discussed the various uniformitarian theories for the formation of the Haymond Formation boulder beds—one of which (now rejected by uniformitarians) was of a glacial origin. Both works demonstrated that physical features commonly attributed to glacial processes could have formed as a result of high-energy erosion, transport and deposition of sediments in the global Flood.

Austin (1986; 1991) documented the effect that changing energy levels, as a result of the explosion of the Mount St. Helens volcano, had on the deposition of volcaniclastics. This work compares favorably to the depositional energy found in the Paraná Basin. Likely a succession of large-scale volcanic-ash eruptions (i.e., pyroclastic flows) and accompanying deciduous material deposited within Spirit Lake could create similar sedimentary conditions now found in the coal-bearing strata in the Paraná Basin. Coffin (1969; 1983) documented the occurrence of poly-strata trees, and attributed them to a high-energy depositional setting associated with the Flood. Similarly, Ager (1993) also admitted that poly-strata trees reflect high-energy conditions, but clung to uniformitarianism.

Turbidites, though widely recognized in the uniformitarian understanding of Earth history, remain a mystery due to limited occurrences and varying stratigraphic signatures. Froede (1998) has reviewed the subject and determined that turbidites are best understood within the catastrophic global Flood of Genesis. Turbidite deposition of the Paraná coal-bearing strata would require the erosion, transport and deposition of clastic sediments and associated plant material—*twice*. The passage of time between the initial and turbidite depositional episodes must have been short to minimize diagenetic or compaction processes. This succession of events would require an unstable shelf setting and an adjacent basin undergoing some form of active tectonism. All of these conditions are predicted in the Flood framework.

An interpretation of the Brazilian coal layers can be accommodated within a biblical framework. Tectonism associated with the Flood created uplift around the incipient basin. Floodwater then eroded and transported materials (sediments and organic plant detritus) from the elevated areas into the Paraná Basin (A similar model for the southern Appalachian coal deposits was proposed for a locale near Spencer, TN—Froede, 2000b). At some later period during the Flood, rifting occurred in the basin which resulted in the extrusion of flood basalt which almost covered the entire basin. It is not currently clear whether the basalts were deposited during the Flood or after the marine water withdrew. The timing could be better constrained by the nature of the basalt/sediment contact (i.e., was the sediment lithified or not prior to basalt emplacement) and the nature/morphology of the volcanic deposits (e.g., pillow features, glassy rinds, etc.) [see Froede, 2000a].

The vertical succession of high-energy deposits (i.e., clastic sediments followed by volcanic outpourings) found within the Paraná Basin would suggest that the majority of the materials were deposited and emplaced during periods of accelerated tectonism initiated during the Middle Flood Event Timeframe (see Reed et al., 1996; Froede, 1998).

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I thank Emmett Williams, Jerry Akridge, and John Reed for their very helpful comments. Mrs. Thajura Harmon provided excellent assistance in securing key references for me and I thank her for this help. As always, I thank my wife Susan for allowing me the time and opportunity to research and write this article. Any mistakes that may remain are my own. Glory to God in the highest! (Prov. 3:5–6).

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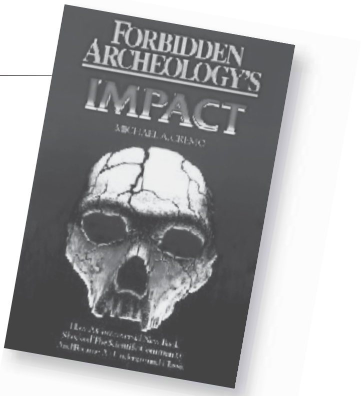
Book Review



***Forbidden Archeology's Impact* by Michael Cremo**
Bhaktivedanta Book Publishing Co., Los Angeles, CA. 1998, 569 pages, $35

Cremo makes the charge that evolutionists have borrowed their view of linear historical progress from Christianity. Instead, he believes in cyclical history in accordance with his Hindu religion to which he converted from "liberal Roman Catholicism" (pp. 57–58). His Hindu belief led to his search for evidence of people in geologic strata that is too early for conventional Darwinism (p. xxxiii). The results were chronicled in his first book, *Forbidden Archeology* (*FA*, 1993) which was "an exercise in apologetics [for the] Vedic texts of India" (p. 199). Peter Line (1995) reviewed that book from a creation perspective. Cremo's new book discusses the reception accorded *FA*. His next intended book *Human Devolution* will attempt to explain the scientific origins of people, *billions* of years ago, in accordance with his Hindu worldview. Cremo has been effective promoting his beliefs at the popular level, and has been given access, appearing on more than 150 radio/TV broadcasts, guest-lecturing at universities, and publishing more than 35,000 copies of *FA*.

It does not appear that Hindus would be good allies for Christians against Naturalism. The reason is that they are attempting to move the scientific center further from Christianity than it is now. Dr. Howells (Harvard) thought that the *FA* research would cause problems for scientific creation (p. 334). That is only true, though, for those varieties (theistic evolution and old-earth creation) that accept the uniformitarian interpretation of the geologic column. Dr. Roger Wescott (p. 427) recognized that the evidence for man in ancient geological strata could be interpreted as evidence *against the supposed great ages* (which is the way young earth creation scientists see these anomalies). What is interesting is that Cremo did not answer Wescott. Though welcoming Cremo's deconstruction of evolutionist archeology and his documentation of how that discipline has filtered out anomalous data, creation scientists are going in the opposite direction from there.

Cremo accused the "fundamentalist Darwinian" who reviewed *FA* for the NCSE's *Creation/Evolution* with misrepresenting him (pp. 169, 182). (I know *CRSQ* members will be surprised at this.) At least ten *FA* reviewers compared the book to Evangelical Christian creation apologetics (pp. 92, 102, 122, 126,164, 188, 200, 202, 242, 261). A French reviewer compared *FA* to Jehovah's Witnesses' creation tracts (p. 113); perhaps Evangelical Christian creation witness is so weak in France, he did not know about it). Islam is yet another religion that is attempting to build a scientific apology for the Koran, besides the Hindu attempt now being reviewed. A great many "alternative science" or new age publications (which is Hinduism repackaged for the US) positively reviewed *FA*. The *Humanist Manifesto I* and *II* affirm belief in the strictly natural origin of people (Kurtz, 1973, pp. 8, 17) and that "no deity will save us" (p. 16). Though Humanism is promoted as a non-religious, objective search for truth, especially in state universities, the US Supreme Court has recognized it to be a religion itself.

Is evidence that challenges evolution deliberately withheld from the general public? When Cremo appeared on the NBC special, *The Mysterious Origins of Man*, the producers tried to get permission to film the human artifacts from geological strata dating from 10–55 million years old, placed at the Phoebe Hearst Museum of Anthropology (University of California) by JD Whitney during the 19'th century. The director of the museum told the producers they could not film the objects because they were understaffed and would have to pay overtime (pp. 267, 477–478). The producers offered to pay any amount of money that would be required to have people out there do this. However, the museum director still refused permission to film the artifacts. Earlier, creation scientist Robert Gentet (1991) was given access to those artifacts, though now, perhaps, the museum curators have realized their implications against Darwinism.

Cremo's correspondence with Dr. Virginia Steen-McIntire (formerly with the US Geological Survey) illumines the Darwinian community's suppression of contrary evidence. She excavated evidence for human habitation at Hueyatlaco, Mexico (p. 413). Dates of nearly 300,000 years were obtained from butchered bone (uranium series) and overlying ash layers (zircon fission track; tephra hydration). Well-made bifacial tools were found there also. No archeologist criticized their work; they just said "it can't be" [that people were living there that early], and she has not been able to find professional employment ever since. Current scientific belief is that people did not come to America until c.20,000 years ago. Cremo wanted to publish photos of the Hueyatlaco tools for *FA*, though he was told he "would be given permission ... only if we gave the tools a date of less than 25,000 years" (p. 448). In another similar occurrence, Dr. Lee from Canada, found stone tools at Sheguiandah on Manitoulin Island, in the Great Lakes. They were in a glacial formation that is thought to be 70,000 years old. He got fired from his job, they would not publish his report, and the tools were taken from him and stored out of sight (p. 448).

The producers of the "Mysterious Origins of Man," broadcast by NBC during 1996, came under intense criticism from Darwinists (pp. 467–534), in part because information was presented by experts that did not hold degrees in the fields they represented. The producers pointed out the hypocrisy of the Darwinian community which unanimously referred to the report written by Kuban and Hastings that the Paluxey River man tracks were false, though neither gentleman is an accredited archeologist, anthropologist, or paleontologist (p. 493).

The Peruvian Ica stones, some of which represent dinosaurs, were mentioned occasionally (pp. 225, 227, 349, 406). However, though their finder, the late Dr. Cabrero, claims they come from a cave, he has not revealed its location. Therefore, Cremo wrote, "one might be justly cautious about accepting the authenticity of the stones; ... [though] equally cautious about rejecting them."

Creation scientists may learn from Cremo that deconstructing evolutionary naturalism does not necessarily establish the Judeo-Christian theory of special creation: there are other religious perspectives too. His documentation of the Darwinian community's fanatical reaction against the anomalous data found by JD Whitney, Dr. Steen-McIntire and Dr. Lee demonstrates once again that Humanism is not an objective search for truth. Instead it is a belief system that censors contrary evidence and persecutes heretics as ruthlessly as any other intolerant religion.

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Photographic Essay

by Peter Klevberg*

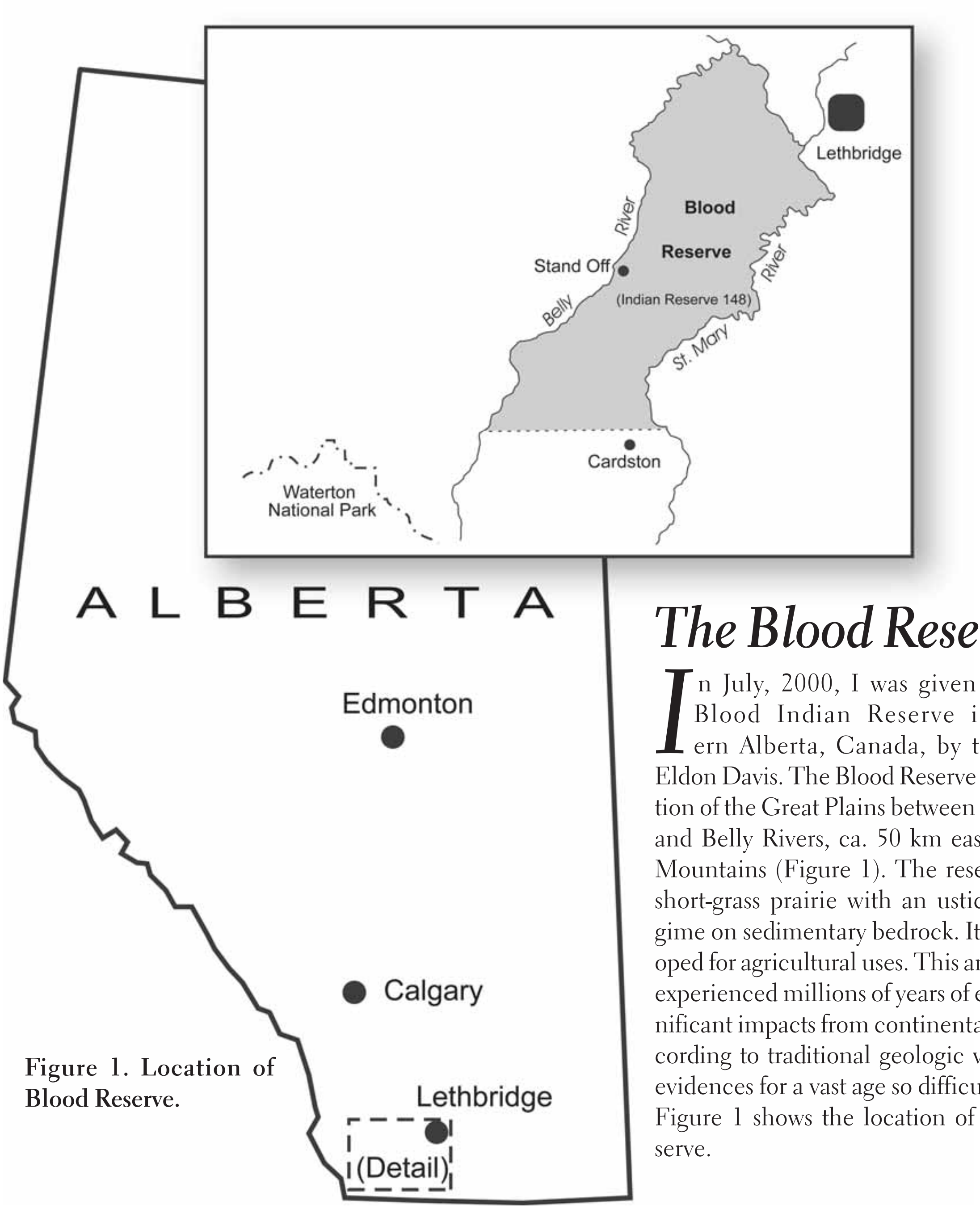

Figure 1. Location of Blood Reserve.

The Blood Reserve

In July, 2000, I was given a tour of the Blood Indian Reserve in southwestern Alberta, Canada, by tribal member Eldon Davis. The Blood Reserve occupies a portion of the Great Plains between the Saint Mary and Belly Rivers, ca. 50 km east of the Rocky Mountains (Figure 1). The reserve consists of short-grass prairie with an ustic[1] moisture regime on sedimentary bedrock. It is partly developed for agricultural uses. This area should have experienced millions of years of erosion and significant impacts from continental glaciation according to traditional geologic views. Why are evidences for a vast age so difficult to find here? Figure 1 shows the location of the Blood Reserve.

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[1] *Ustic* refers to a soil moisture regime which in this region occurs in areas with annual precipitation of approximately 12 to 24 inches (30 to 60 cm) in a pattern resulting in dry soils during more than half of the growing season.]

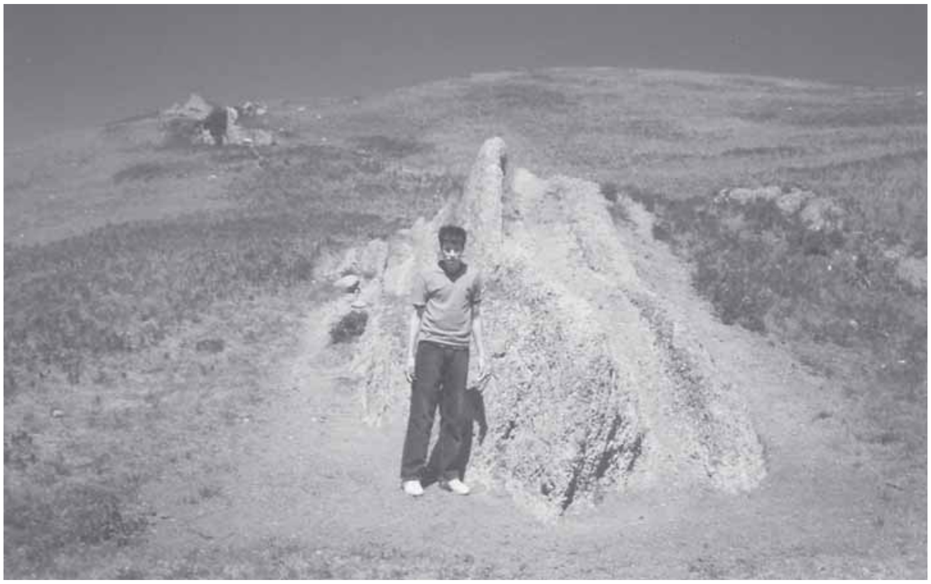

Figure 2. Outcrops of steeply southwest-dipping shell hash limestone (coquina) on rolling terrain devoid of glacial evidences. According to the traditional view of earth history, this region experienced many thousands of years of glaciation.

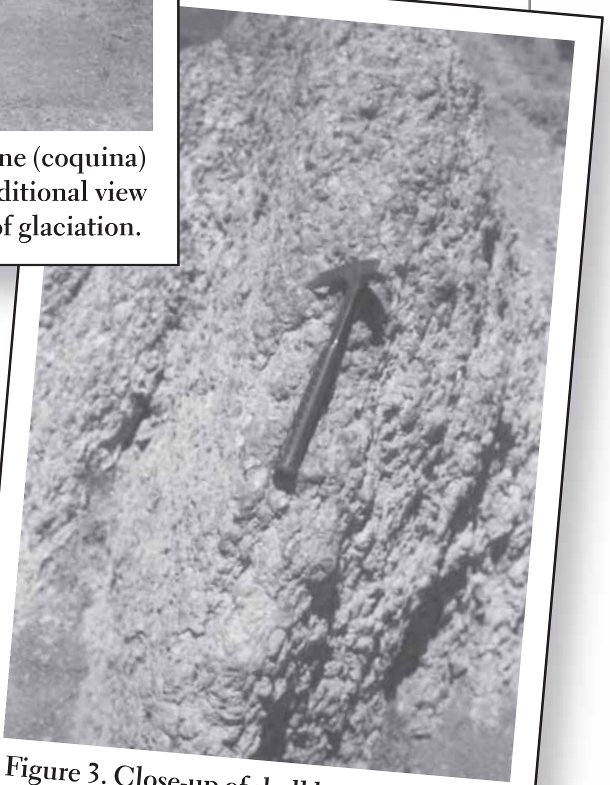

Figure 3. Close-up of shell hash. Small bodies of coquina are generally interpreted as storm deposits. Laterally extensive, highly fossiliferous strata such as these are almost certainly diluvial.

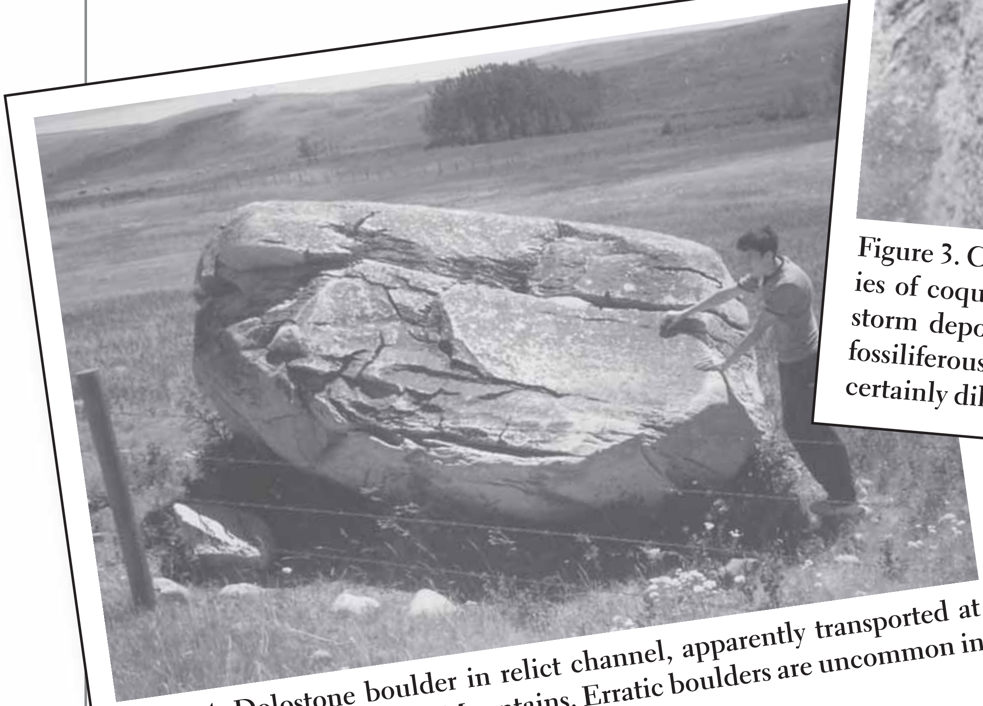

Figure 4. Dolostone boulder in relict channel, apparently transported at least 50 km from the Rocky Mountains. Erratic boulders are uncommon in this area.

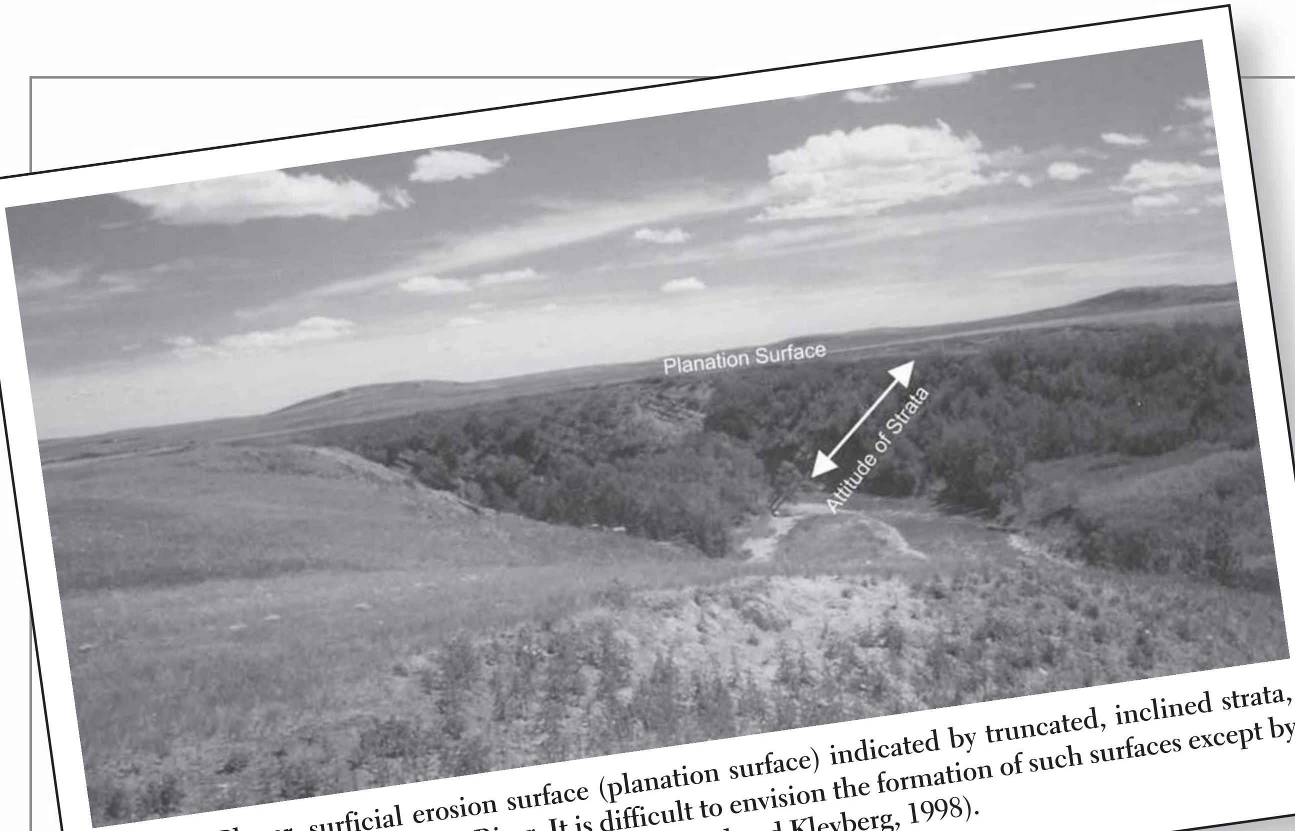

Figure 5. Planar, surficial erosion surface (planation surface) indicated by truncated, inclined strata, exposed along east side of Belly River. It is difficult to envision the formation of such surfaces except by means of the Deluge (Klevberg and Oard, 1998; Oard and Klevberg, 1998).

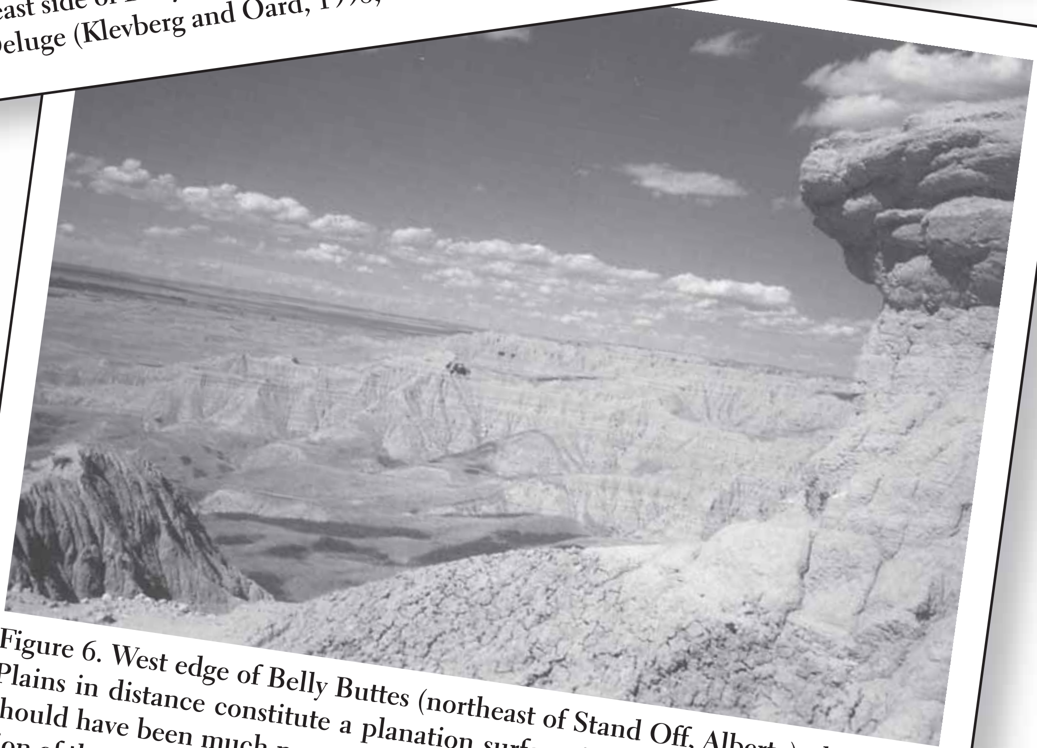

Figure 6. West edge of Belly Buttes (northeast of Stand Off, Alberta); the Great Plains in distance constitute a planation surface. Erosion of the remnant hills should have been much more extensive in the traditional timescale, and formation of the plains remains inexplicable for evolutionists (Crickmay, 1932, 1965).

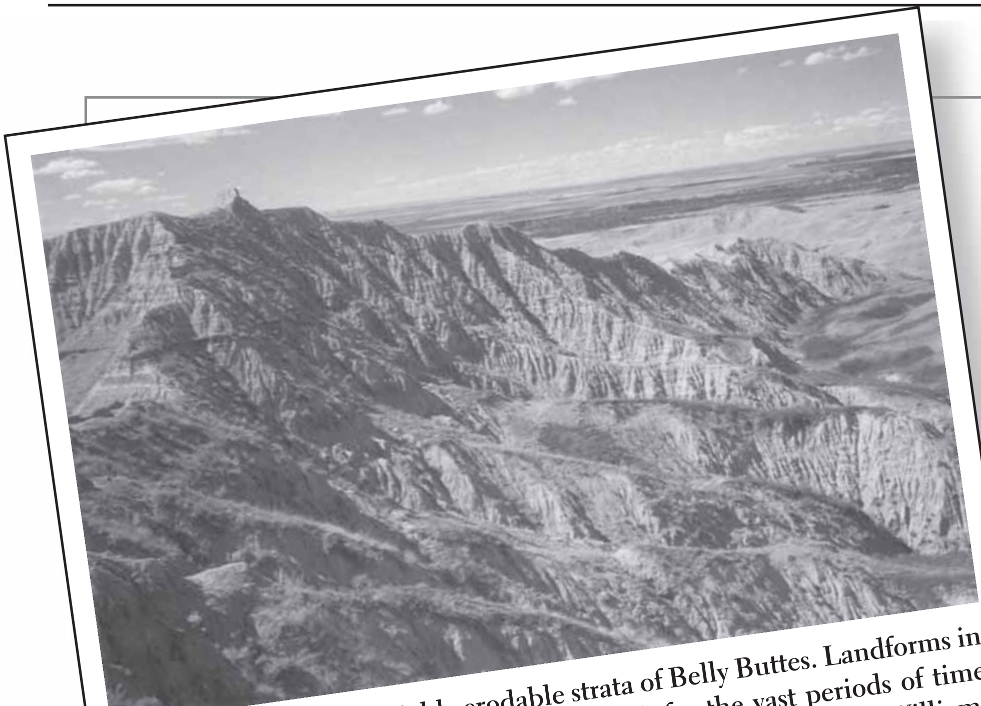

Figure 7. Colorful and highly erodable strata of Belly Buttes. Landforms in many places exhibit rates of erosion too high for the vast periods of time commonly ascribed to their formation, as has been observed by Williams (1995) and others.

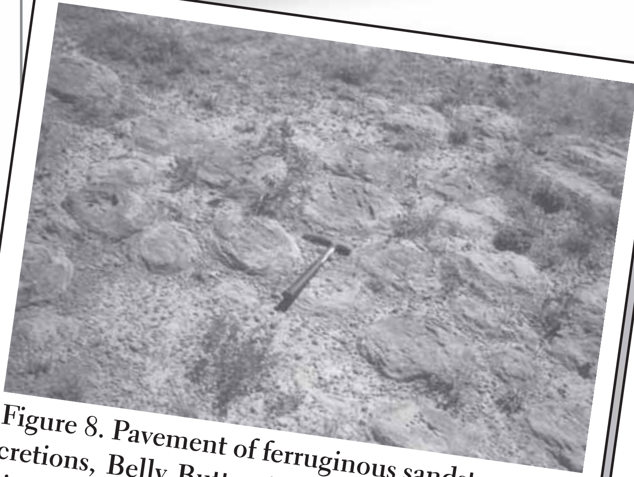

Figure 8. Pavement of ferruginous sandstone concretions, Belly Buttes. The formation of concretions remains a geological enigma (Corliss, 1980, pp. 560–570; Froede, 1998, p. 35).

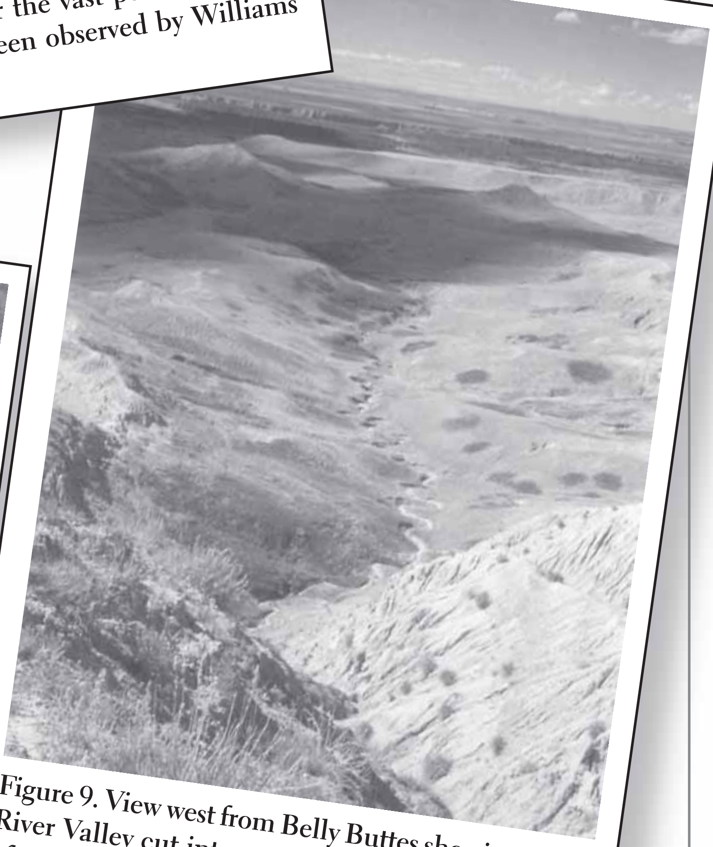

Figure 9. View west from Belly Buttes showing Belly River Valley cut into vast planation surface devoid of prominent glacial features. Where are the cumulative effects of multiple continental and cordilleran ice sheets? Observations fit much better with the idea of a single, relatively short, postdiluvial ice age (Oard, 1990).

Acknowledgements

I thank Eldon Davis for making this field trip possible. *Deum laudo* (Malachi 1:11).

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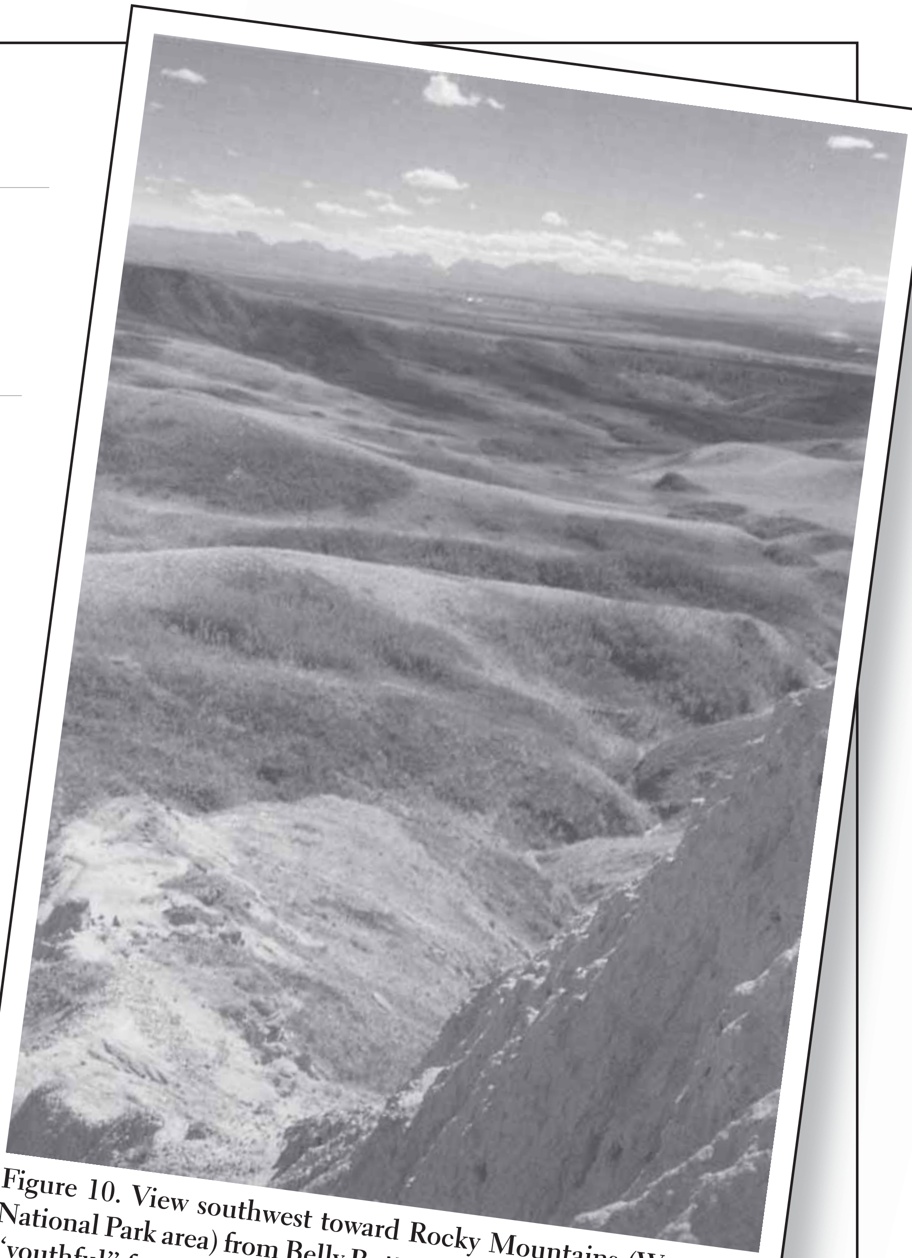

Figure 10. View southwest toward Rocky Mountains (Waterton National Park area) from Belly Buttes. These geomorphologically "youthful" features may appear youthful because they are!

The Origin of the Brain and Mind

Brad Harrub and Bert Thompson*

Abstract

The human brain—arguably the most complex matter in the Universe—performs thousands of unusual and unique mental functions. Within that three pounds of grey matter, exist over 10 billion neurons containing education, memories, communication skills, emotions, likes and dislikes—yet all the while that same three pounds of matter continues to regulate bodily functions. Many have denounced the Cartesian dualistic view of brain and mind, suggesting instead that all human experiences can be explained simply by the firing of neurons. According to some, there is nothing in the mind except neuronal activity. But this would mean that emotion-based responses such as tears and laughter are solely products of organic evolution—something that were "naturally selected for" in humans. Evolutionists ascribe the brain's origin to nothing more than a triune layering of various animal-stage brains. Many believe that the fossil record supports this gradual increase in brain size over eons of time as humans allegedly improved their mental faculties. However, we know today that human brains vary greatly in size, and that no evidence exists to demonstrate a relationship between brain size and intelligence. The precision, complexity, and interconnectivity of the brain indicate that it was not laid down in layers. While many questions regarding the human brain still remain, its origin cannot be explained by current evolutionary theory. The ability of the human brain to interact with the human mind clearly points to an Almighty Creator.

(Note: In this paper, SMALL CAPS indicate emphasis in original; *italics* indicate emphasis added. Words in [brackets] added by the authors.)

Introduction

On July 17, 1990, U.S. President George H.W. Bush declared that the years between 1990 and 2000 were to be designated as the "Decade of the Brain," and announced that this declaration was intended "to enhance public awareness of the benefits to be derived from brain research" through "appropriate programs, ceremonies, and activities." Millions of grant dollars were shifted toward neurobiological studies to encourage neuroscientists to try to answer some basic questions in this area. It was during this "decade of the brain" that I found myself completing my graduate degree in the neurobiology department at the University of Tennessee Medical School. Those years of in-depth study taught me a great deal about the anatomy and physiology of the brain, and about how it works within the body as a whole. But they also taught me that, as scientists, we are far from unlocking all the secrets that this incredible structure holds. In fact, scientists are not always sure how they can unlock the remaining secrets. We now possess the ability to record the activity from a single neuron located deep within the brain, but we can only speculate about the role that particular activity plays in such things as memories or emotions. The more we learn about this complex group of cells, the more we realize we do not know much about the "big picture."

I vividly recall an occasion in which those of us in one of my graduate classes were being asked to explain the molecular events that transpire when a neuron fires. The professor phrased the question something like this: "Suppose for a minute that you want to remember a phone number, what events would take place at the cellular level within the basal ganglia during that thought process?" After a lengthy discussion about calcium and sodium channels, a student in the back of the class spoke up and said, "Yeah, but where would that phone number be stored, and exactly how does the brain remember things?" The professor's answer: We don't know. Robert Ornstein and Richard Thompson summed it up well when they stated: "After thousands of scientists have studied it for centuries, the only word to describe it remains AMAZING" (1984, p. 21).

Consider this simple test. Read the following sentence: *Mom had hot apple cider ready for us on that cold snowy day*. In the seconds that were required for you to complete

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Figure 1. The human brain. LifeART image copyright (2003) Lippincott Williams & Wilkins. All rights reserved.

the sentence, your brain already had carried out a multitude of tasks. Initially, your eyes focused on the piece of paper on which the sentence was written, and then transmitted the visual stimuli chemically via your optic nerve to your brain. The brain received that chemical signal, and immediately recognized the symbols on the page as English letters. It then compiled those letters into an entire sentence (using rules that you learned long ago in elementary school), which it analyzed and comprehended. In addition, your brain also may have painted a mental image of this snowy day and your mother. You may even have found yourself suddenly craving a mug of hot apple cider. Also, during that short span, your ears reported any unusual sounds, and your nose constantly was sampling the air for new odors. All the while, your brain was keeping your body at homeostasis—that is, it signaled your heart to beat and your lungs to respire, it measured hormone levels in your blood stream (and made adjustments as needed), and relayed any pain or sensation that you might be feeling during those few short seconds. And all of this is merely the proverbial "tip of the iceberg." The brain, and the nerves associated with it, carry out countless physiological functions, most of which we understand at only a very basic level. Again, truth be told, we have yet to understand exactly how this unique organ can perform all of these functions simultaneously and with such marvelous precision.

And therein lies the enigma surrounding the brain. How can we take three pounds of matter, and in that small space cram all of our education, memories, communication skills, emotions, likes, and dislikes—yet, all the while it is those same three pounds of matter that keep our heart beating, cause our lungs to respire, and give us a detailed internal map of the position of our arms or legs? How is it that a certain smell instantaneously can carry us back to a period in our childhood, offering us crystal clear images of that particular time in our life? Exactly how is it that we can distinguish between a banana and an orange, just by using our nose? What chemical reactions occur to tell us which one is an orange? *Where* is that memory stored, and how long will that memory *remain* stored? What part of our brain controls our emotions? Where do we hold feelings such as love and hate? How is it that the sound of one voice can bring tears of joy, while sounds from another can cause our blood pressure to begin to climb? In fact, why is it that humans love at all?

As vexing as these questions are, they are even more troubling for individuals who espouse that the brain arrived here by Darwinian mechanisms. Evolutionists would like us to believe that the brain is nothing more than an advanced computer—it receives input (via the senses), and after the input makes its way through various neuronal circuits, output is the end result. Input equals output. Ornstein and Thompson speculated: "What exists as only a few extra cells in the head of the earthworm, handling information about taste and light, has evolved in us humans into the incredibly complex and sophisticated structure of the human brain" (1984, p. 22). These sentiments no doubt are shared by thousands of individuals who stand in utter awe of the brain, yet who chalk up its existence to pure happenstance. Is the brain merely the product of evolution, or were humans created differently than animals?

History of the Brain

The earliest known reference to the brain anywhere in human records was written on papyrus in the seventeenth century B.C. (see Breasted, 1930). According to James Breasted, the individual who translated and published the contents of that document, the word "brain" occurs only eight times in Egyptian history, six of them on the pages of the Smith Papyrus describing the symptoms, diagnosis, and prognosis of two patients suffering from compound fractures of the skull. The organ that we commonly refer to as the brain has not always held a revered status in the eyes of men. In fact, the brain was given little importance by ancient Egyptians who believed that it cooled the body and did little else. As these skilled preservers of the dead prepared bodies for mummification, they excised the brain through the nose with a wire loop and discarded it. Often, the brain simply was pitched into the sand (primary attention was given to the heart, which they considered the most important organ of the body). The classical Greeks, to whom we owe so many ideas, also were divided over whether the heart or the brain served as the seat of one's intellect. The famed Hippocratic writers rightly believed the brain to be the dominant location for things like intelligence and passion. Plato also taught that the brain was the supreme organ of the body, assigning to it such things as emotions, passions of the heart, and even appetites of the belly. Aristotle, a student of Plato, contended on the other hand that the heart was the center of thought and sensation, believing that the brain worked as a refrigerator to cool the heart (which is ironic, now that we know the brain generates the most heat!). And so, the debate continued for centuries.

At the time the Old Testament was translated into Greek (finished sometime during the second century B.C.), the majority of people adhered to Aristotle's viewpoint, and believed that the heart was the center of understanding. The Scriptures are replete with references to man's intellect and emotions as residing in "the heart"—what we now refer to as "the mind." The King James Version lists 830 occurrences of the word heart in over 762 verses. Just a short period after Christ walked this Earth, a philosopher by the name of Galen (A.D. 130–200) realized Aristotle's mistake, and noted that the "power of sensations and of movement flows from the brain" and that "what is rational in the soul has its existence there" (as quoted in Fincher, 1984, p. 13). He went on to question: "Why is the brain capable of cooling the heart, and why is the heart not rather capable of heating the brain which is placed above it, since all heat tends to rise? And why does the brain send to the heart only an imperceptible nerve while all the sensory organs draw a large part of their substance from the brain?" Unfortunately, however, early human anatomy was based on a combination of animal dissections and fertile imagination, which only perpetuated the confusion, allowing Shakespeare (1546–1616) to have Portia question, "Tell me, where is fancy bred, Or in the heart or in the head?"

Great discoveries about human physiology and the structure of the human brain were made during the Renaissance Period. Leonardo da Vinci discovered that he could pour wax into the ventricles (open spaces) of an ox brain, and then strip away the flesh after it had cooled. The hardened wax model that resulted, represented the true shape of the cavities that had remained clandestine within the brain for millennia. In the nineteenth century, the debate over the brain/mind erupted into a furor, led by these famous words:

"What is mind?" —— "No matter."
"What is matter?" —— "Never mind."

Eventually, anatomy revealed the truth, and cardiocentric believers found themselves jarred by the fact that during embryonic formation, nerves developed directly from the brain, while blood vessels developed independently from the heart. Further human dissections firmly established that the heart was more or less a pump, while the brain held all of the intricate secrets of consciousness and the senses, including emotions such as love. However, some theories die hard. For instance, we challenge you to find a Valentine's card with a picture of a **brain** with an arrow going through it. While we know that the heart is not the center of our emotions, many people still make references such as "you always will hold a special place in my heart."

Thus, after years of deliberating and conjecture, the cerebral cortex began to be viewed as more than a mere radiator for the heart. Paradoxically, before men even speculated on its higher functions, part of the answers already had been recorded: "…It is to be conceived that the motor force, or the nerves themselves, take their origin from the brain, where fantasy is located" (see Fincher, p. 16). French mathematician René Descartes, who was born in France in 1596, made this fitting declaration. During his lifetime, a series of biological discoveries rocked the scientific world, and stimulated Descartes to probe the brain. He was devoutly religious, and his philosophy was a bold attempt to reconcile scientific methods while remaining true to his faith in God. Descartes was the one who penned those famous words, "*cogito ergo sum*" ("I think, therefore I am"). Accordingly, Descartes defined thinking as the whole range

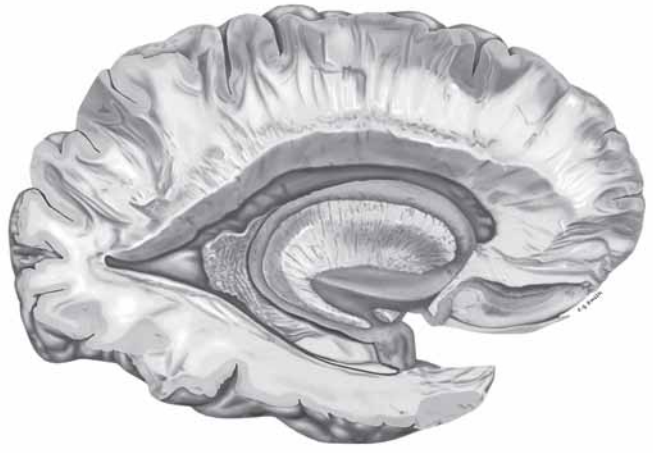

Figure 2. Cerebral hemisphere dissection showing the cortex. LifeART image copyright (2003) Lippincott Williams & Wilkins. All rights reserved.

of conscious mental processes—intellectual thoughts, feeling, will, and sensations. He was of the firm opinion that the mind always was at work, even during periods of sleep. Based on his work, Descartes made a complete and total division between mind and body—one far more drastic than Plato's. Descartes' work was very important because it established "a modern philosophical basis for the belief that a human being lives a dual existence involving a spiritual soul and a body" (Elbert, 2000, p. 217). However, he believed that the body and soul interacted at a particular place, and he unfortunately felt obligated to try to determine that place. Due to the insufficient knowledge of Descartes' day, he concluded that the interaction took place in the pea-sized pineal gland—a structure that we now know is an endocrine glad that manufactures and secretes melatonin in accordance with our circadian rhythms.

The Evolution of the Brain

If you were to walk into a neuroanatomy class at a major medical school, you very likely would find more than fifty white porcelain buckets—each filled with preservative fluids and containing a brain that had been collected from a donor cadaver. The first thing you would notice as you examined the physical mass of the brain probably would be the various convolutions and wrinkles (known as sulci) that cover the entire surface. Had the brain not been soaking for weeks in a fixative such as formaldehyde, you would be able to see that the brain itself is extremely soft, with almost a custard-like consistency. Upon cutting the brain in half, you would observe what appear to be striations in various areas, and you would find various hollow ventricles that normally are bathed in cerebrospinal fluid. Hidden within this gray and white tissue is the most intricately wired communication network in the world.

Those three pounds of "matter" represent literally billions of interconnected nerve cells and millions of protective glial cells—which, according to evolutionists, arose by the effects of time, natural law, and chance from nonliving matter. The brain has been estimated to contain 100 billion (10^{11}) neurons (Kandel, 1991, p. 18), each a living unit within itself. While most neurons share similar properties, they can be classified into "perhaps as many as 10,000 different types" (p. 18). Over 100 thousand billion electrical connections are estimated to be present throughout the human brain, which has been said to be more than "all the electrical connections in all the electrical appliances in the world." In describing this awesome organ, R.L. Wysong wrote:

> The human brain weighs about three pounds, contains ten billion neurons with approximately 25,000 synapses (connections) per neuron. Each neuron is made up of 10,000,000,000 macromolecules. The human mind can store almost limitless amounts of information (a potential millions of times greater than the 10^{15} bits of information gathered in a lifetime), compare facts, weigh information against memory, judgment and conscience and formulate a decision in a fraction of a second (1976, p. 340, parenthetical item in orig.).

The brain, arguably, is the most unique organ in the entire body—not merely because of its physical make-up, but because of *what* it does and *how* it does it. As evolutionist George Bartelmez put it many years ago: "Only a single fundamental organ has undergone great specialization in the genus *Homo*. This is the brain" (1926, p. 454). Today, from an evolutionary perspective, that assessment still is viewed as correct. As Johanson and Edgar noted seventy years later: "This change in both size and shape represents one of the most remarkable morphological shifts that has been observed in the evolutionary history of any mammal, for it entailed both an enhanced cranial capacity and a radical reorganization of brain proportions" (1996, p. 83).

We believe that the brain deserves a great deal more respect than evolutionists are willing to afford it. The late evolutionist Isaac Asimov characterized the human brain as "the most complex and orderly arrangement of matter in the universe" (1970, p. 10). When Paul Davies, professor of mathematics and physics at the Universe of Adelaide, referred to it as "the most developed and complex system known to science" (1992, 14[5]:4), he did not overstate the case. Nuland wrote in regard to the human brain:

> Though the three pounds represent a mere 2 percent of the body weight of a 150-pound person, the quartful of brain is so metabolically active that it uses 20 percent of the oxygen we take in through out lungs. To supply this much oxygen requires a very high flow of blood. Fully 15 percent of the blood propelled into the aorta with each contraction of the left ventricle is transported directly to the brain. Not only does the brain demand a large proportion of the body's oxygen and blood but it also begins its life requiring an equivalent share, or even more, of its genes. Of the total of about 50,000 to 100,000 genes in *Homo sapiens*, some 30,000 code for one or another aspect of the brain. Clearly, a huge amount of genetic information is required to operate the human brain.... From all of this emerges the brain's overarching responsibility—it is the chief means by which the body's activities are coordinated and governed (1997, pp. 328, 346).

Since Nuland's statement was made, the human genome project has been completed, and the latest estimates the entire human genome are approximately 30,000 genes. However, the point should not be lost that a great percentage of those genes code for "one or another aspect of the brain." James Trefil addressed the brain's complexity when he wrote:

> The brain is a physical system. *It contains about 100 billion interconnected neurons—about as many neurons as there are stars in the Milky Way galaxy*…. In the end, by mechanisms we still haven't worked out (but we will do so!), these signals are converted, by neurons in different parts of the brain, into the final signals that produce images or smells or sounds… (1996, pp. 217–218, parenthetical item in orig.).

Notice Trefil's admission that the brain works "by mechanisms we still haven't worked out." Ian Tattersall, in his book, *Becoming Human*, wrote in a similar fashion in describing the brain's marvelous sophistication—while admitting that "there's a huge amount that we don't know."

> [T]he brain is an extremely power-hungry mechanism that, because of its size, monopolizes some 20 percent of our entire energy intake…. But the matter doesn't rest there, for sheer brain size is far from the full story. *The organization—the structure—of our brains is also unique, and it is this that appears to hold the ultimate key to our remarkable cognitive powers*. There's a huge amount, of course, that we don't know about how the brain works and especially about how a mass of chemical and electrical signals can give rise to such complex effects as cognition and consciousness (1998, pp. 69, 70).

The point in Dr. Tattersall's last sentence is well taken. There is a "*huge amount that we don't know*"—including (among other things) how "a mass of chemical and electrical signals can give rise to such complex effects as cognition and consciousness." [Pardon us if we are a bit skeptical of Trefil's exuberant suggestion, "but we will do so!" On this topic, we agree wholeheartedly with Robert Jastrow of NASA, who admitted: "Is it possible that man, with his remarkable powers of intellect and spirit, has been formed from the dust of the earth by chance alone? It is hard to accept the evolution of the human eye as a product of chance; it is even harder to accept the evolution of human intelligence as the product of random disruptions in the brain cells of our ancestors.… Among the organs of the human body, none is more difficult than the brain to explain by evolution. The powers that reside in the brain make man a different animal from all other animals" (1981, pp. 98–99,104).] Tattersall suggested: "Little as we understand the highly complex workings of our brains in producing consciousness, it is clear that there is a 'whole brain' effect in the production of our prized awareness" (2002, p. 73). But, the "whole brain" idea does not get us very far, as Daniel Dennett admitted in *Consciousness Explained*.

> [T]he trouble with brains, it seems, is that when you look in them, you discover that THERE'S NOBODY HOME. No part of the brain is the thinker that does the thinking or the feeler that does the feeling, and the whole brain appears to be no better a candidate for that very special role (1991, p. 29).

Yet in spite of the fact that when we look at the brain, "there's nobody home," and in spite of the fact that "neuroscience is said to be awash with data about what the brain does, but virtually devoid of theories about how it works" (Lewin, 1992, p. 163), there are some things we *do* know.

> The brain, although being THE MOST COMPLEX STRUCTURE EXISTING ON EARTH—AND PERHAPS IN THE UNIVERSE—is a well-defined object: it is a material entity located inside the skull, which may be visualized, touched and handled. It is composed of chemical substances, enzymes and hormones which may be measured and analyzed. Its architecture is characterized by neuronal cells, pathways and synapses. Its functioning depends on neurons, which consume oxygen, exchanging chemical substance through their membranes, and maintaining states of electrical polarization interrupted by brief periods of depolarization (Cardoso, 1997/1998).

> The brain is a helmet-shaped mass of gray and white tissue about the size of a grapefruit, one to two quarts in volume, and on average weighing three pounds (Einstein's brain, for example, was 2.75 pounds). Its surface is wrinkled like that of a cleaning sponge, and its consistency is custardlike, firm enough to keep from puddling on the floor the brain case, soft enough to be scooped out with a spoon…. *The human genome database accumulated to 1995 reveals that the brain's structure is prescribed by at least 3,195 distinctive genes, 50 percent more than for any other organ or tissue*… (Wilson, 1998, p. 97, parenthetical item in orig.).

> Some overall descriptions of the properties of the human brain are instructive. For instance, *10 billion neurons are packed into the brain, each of which, on average, has a thousand links with other neurons, resulting in more than sixty thousand miles of writing. Connectivity on that scale is beyond comprehension*, but undoubtedly it is fundamental to the brain's ability to generate cognition. Although individual events in an electronic compute happen a million times faster than in the brain, *its massive connectivity and simultaneous mode of activity allows biology to outstrip technology for speed*. For instance, the faster computer clocks up a billion or so operations a second, which pales to insignificance beside the 100 billion operations that occur in the brain of a fly at rest…. To say that the brain is a computer is a truism, because, unques-

> tionably, what goes on in there is computation. But so far, no man-made computer matches the human brain, either in capacity or design…. Can a computer think? And, ultimately, can a computer generate a level of consciousness… (Lewin, 1992, pp. 160,163,).

> The human brain's increase in neurons is due to its greater size, not to greater density, since humans have only about 1.25 as many neurons per cubic centimeter as chimpanzees do. There are approximately 146,000 neurons per square millimeter of cortical surface. The human brain has an area of about 2,200 square centimeters and about 30 billion neurons (more than assumed until quite recently). The chimpanzee and the gorilla have brains of about 500 square centimeters, and with about 6 billion neurons (Ornstein, 1991, p. 63, parenthetical item in orig.).

Can anyone—after reading descriptions (and admissions!) such as these—really believe that the human brain is "only another organ," as Michael Lemonick claimed in *Time* magazine (2003a, 161[3]:66)? Not without denying the obvious! In the January 16, 1997 issue of *Nature*, Sir Francis Crick's close collaborator, Christof Koch, wrote: "The latest work on information processing and storage at *the single cell (neuron) level reveals previously unimagined complexity and dynamism*" (385:207, parenthetical item in orig.). His concluding remarks were: "As always, we are left with a feeling of awe for the amazing complexity found in Nature" (385:210). Amazing complexity indeed!

A case in point is British evolutionist Richard Dawkins. In the preface to his book, *The Blind Watchmaker*, he discussed the brain's incredible complexity and "apparent design," and the problem posed by both.

> The computer on which I am writing these words has an information storage capacity of about 64 kilobytes (one byte is used to hold each character of text). The computer was consciously designed and deliberately manufactured. The brain with which you are understanding my words is an array of some ten million kiloneurones. Many of these billions of nerve cells have each more than a thousand "electric wires" connecting them to other neurons. Moreover, at the molecular genetic level, every single one of more than a trillion cells in the body contains about a thousand times as much precisely coded digital information as my entire computer. *The complexity of living organisms is matched by the elegant efficiency of their apparent design. If anyone doesn't agree that this amount of complex design cries out for an explanation, I give up* (1986, p. ix).

But, after having described the brain's immense complexity and "apparent" design, and after being just about ready to "give up," he reconsidered, and wrote:

> No, on second thought I don't give up, because one of my aims in the book is to convey something of the sheer wonder of biological complexity to those whose eyes have not been opened to it. But having built up the mystery, my other main aim is to remove it again by explaining the solution (p. ix).

He then spent the remainder of the book informing the reader (using, of all things, well-designed computer programs) that the design in nature is merely "apparent," not "real."

But, the question lingers: How did natural selection produce the human brain? Basically, there are two views within the evolutionary camp. Some, like MIT's Steven Pinker, believe that the brain can be broken down into individual components, each of which evolved for specific purposes (see Morris, 2001, p. 208). To quote Pinker:

> The mind, I claim, is not a single organ but a system of organs, which we can think of as psychological faculties or mental modules…. The word "module" brings to mind detachable, snap-in components, and that is misleading. Mental modules are not likely to be visible to the naked eye as circumscribed territories on the surface of the brain, like the flank steak and the rump roast on a supermarket cow display. A mental module probably looks more like roadkill, sprawling messily over the bulges and crevasses of the brain (1997a, pp. 27,30).

Others, having been heavily influenced by a theory set forth by the late paleontologist, Stephen Jay Gould, and his close friend, population geneticist Richard Lewontin, take a different approach. These two Harvard professors advocated the view that the brain evolved for its own set of reasons, and that certain human traits then followed that had nothing whatsoever to do with natural selection. According to Gould:

> …[T]he brain got big by natural selection for a small set of reasons having to do with what is good about brains on the African savannas. But by virtue of that computational power, *the brain can do thousands of things that have nothing to do with why natural selection made it big in the first place*…. Natural selection didn't build our brains to write or to read, that's for sure, because we didn't do those things for so long (1995).

Since written language is allegedly a relatively recent evolutionary invention, then it could not be an ability that evolved during ancestral times as hominids roamed the savannas of Africa. Gould's point, then, is that the ability to read and write must be a by-product of the way the brain itself is constructed. Indeed, says Gould, it would be easy to construct quite a large list of human intellectual abilities that could not have been shaped by natural selection. Such a list might include such things as the ability to learn higher mathematics, to understand complicated games like chess, to play a violin, and perhaps even to form linguistic constructions.

In addition to reading and writing, Dr. Gould cited consciousness as a "quirky accident" that was simply a fortuitous, unexpected by-product of the brain having evolved and gotten bigger. A brief history lesson is in order.

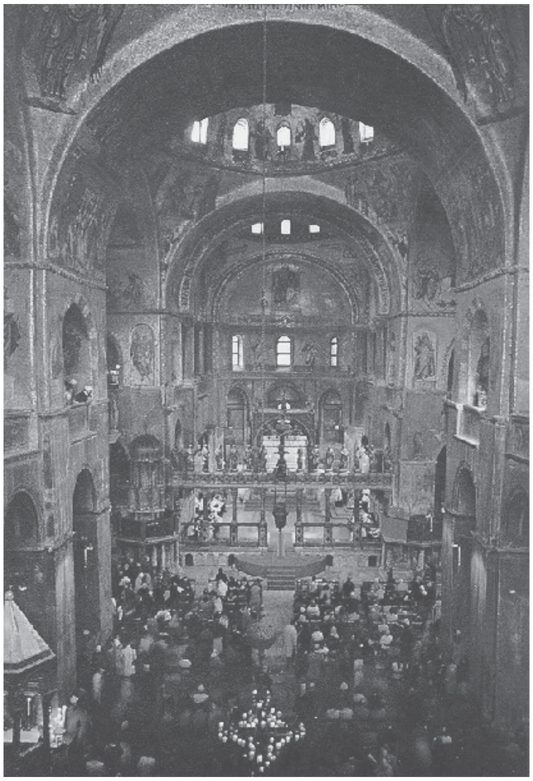

Figure 3. The spandrels of San Marco. Image courtesy of Alan Humm.

In 1978, the Royal Society of London sponsored a symposium on the subject of "adaptation." Dr. Lewontin had been invited to attend, but he does not care much for airplanes. He asked his friend Dr. Gould to co-author the paper with him, and then to present it at the British Symposium. The paper was titled "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme" (see Gould and Lewontin, 1979), and became famous practically overnight. [Note: When Gould and Lewontin referred to the "Panglossian paradigm" in the title of their paper, they were alluding to the ideas espoused by Dr. Pangloss in Voltaire's famous novel, *Candide*. In his novel, Voltaire satirized the beliefs of the eminent German philosopher Gottfried Wilhelm von Leibniz, who maintained that this was "the best of all possible worlds." According to Dr. Pangloss, in this best of all words, everything existed for a purpose. For example, in explaining to Candide why he had contracted syphilis, Dr. Pangloss said: "It is indispensable in this best of all possible worlds. For if Columbus, when visiting the West Indies, had not caught this disease, which poisons the source of generation, which frequently even hinders generation, and is clearly opposed to the great end of Nature, we should have neither chocolate nor cochineal" (see Morris, 2001, p. 85).]

The Gould/Lewontin paper (which was published a year later in 1979) began with a description of the central dome of St. Mark's Church (*San Marco* in Italian), located in Venice. The dome is supported by two distinct arches, which meet at right angles. The arches divided the dome into four tapering, triangular spaces. As Gould and Lewontin noted, these spaces are an unavoidable by-product of mounting a dome on two rounded arches; the arches could not divine the inner surface of the dome in any other way.

These spaces are known as spandrels. [The term spandrel actually was misapplied by Gould and Lewontin. As it turns out, the correct term is "pendentive," as several authors have pointed out; see Houston, 1990, pp. 498–509; Dennett, 1995, pp. 271–275; Ruse, 2001b, p. 236).] In the spandrels, artisans painted mosaics of the four biblical evangelists (Matthew, Mark, Luke, and John) and mosaic images representing the Tigris, Euphrates, Nile, and Indus rivers. Gould and Lewontin pointed out that the spandrels were not created by the architect for any specific purpose. On the contrary, they were "non-adaptive side effects"; the spandrels *had* to be there. They were not created for the *purpose* of housing mosaics; they were decorated because there were *empty spaces* to be filled.

According to Gould and Lewontin, a similar phenomenon occurs during the course of evolution. Organisms, they suggested, possess numerous traits that were not molded by natural selection. The traits exist because they are by-products of something else (see Schwartz, 1999). This does not mean that these traits are not useful. Once a spandrel exists, natural selection supposedly was able to modify it in some way to make it useful, just as the architects of San Marco found that the triangular spaces (spandrels) could be used for decorative mosaics. Spandrels often turned out to be useful when adapted for some purpose, but, as Gould and Lewontin noted, the spandrels originally evolved for secondary purposes. They therefore could not be attributed directly to natural selection.

Three years later, Gould and Yale University paleontologist Elisabeth Vrba invented the term "exaptation" to define and illuminate the role played by spandrels. What, exactly, is an exaptation? Gould explained: "…[W]hat shall we call structures that contribute to fitness but evolved for other reasons and were later co-opted for their current role? They have no name at present, and [Elisabeth] Vrba and I suggest that they be called 'exaptations'" (1984, p. 66; for Vrba reference, see Gould and Vrba, 1982). Thus, exaptations are spandrels that organisms have adapted for some useful purpose. In a 1997 article he authored for the

New York Review of Books ("Evolution: The Pleasures of Pluralism"), Gould wrote: "Natural selection made the human brain big, but most of our mental properties and potentials may be spandrels—that is, nonadaptive side consequences of building a device with such structural complexity" (1997, 44[11]:52).

From an evolutionary viewpoint, the "extraordinary increase in the human brain size was *the fastest evolutionary transformation known*" (Ornstein, 1991, p. 35). On some levels, it might make sense that the larger the brain, the more intelligent the animal. However, we now know that brain size does not determine intelligence. The tiny mouse lemur (*Microebus murinus*) has a brain that represents three percent of its overall body weight, whereas the human brain accounts for only two percent, and yet this tiny mouse cannot talk or make complex tools. Simply put, brain size does not determine intelligence. Tattersall put it this way:

> *We know remarkably little about the actual sequence of events in human brain enlargement over time. Even less do we understand the effects of these events*…. Intuitively, from a human vantage point, it's hard to avoid the conclusion that, somehow, brain expansion is intrinsically a good thing—though perhaps the contemplation of the extreme rarity of this phenomenon in nature should make us think again…. *[A]s it turns out, the concept of a gradual increase in brain size over the eons is actually rather problematic. For a start, this idea strongly implies that every ounce of extra brain matter is equivalent in intelligence production to every other brain ounce—which is clearly not the case* (2002, pp. 67,68).

No evidence exists that demonstrates a relationship between brain size and intelligence within any given species. The human brain, for example, is known to have a range in volume from less than 1,000 to more than 2,000 cubic centimeters. In fact, some of the most intelligent people in history had small brains.

Yet, evolutionists often classify hominid fossils largely according to brain size (see the chart in Pinker, 1997a, pp. 198–199)! They assume that the human brain started out in primates as a relatively small organ, and then evolved through time to the size we now see it. Peter Wilson commented on this in his book, *Man the Promising Primate*:

> We distinguish hominid fossils from other primate remains partly by the relative size of the braincase. As we move from *Australopithecus africanus* to *Homo habilis*, *Homo erectus*, and finally *Homo sapiens*, we have a creature whose probable brain size increases from 400 cubic centimeters to 1,500 cubic centimeters. That brain is housed in a cranium that becomes more and more vaulted, loses its ridges and crests, and shows more and more evidence of a forehead and backhead (1980, p. 45).

Gould, however, concluded one of the chapters in his book, *Ever Since Darwin*, by asking:

> But *why* did such a large brain evolve in a group of small, primitive, tree-dwelling mammals, more similar to rats and shrews than to mammals conventionally judged as more advanced? And with this provocative query I end, for *we simply do not know the answer to one of the most important questions we can ask* (1977, p. 191).

Growing a bigger brain is not quite as straightforward as it first might appear. It is not simply a matter of "putting on weight" like one does with his or her body. Every neuron that is "added" must be of the right kind (excitatory or inhibitory), must possess the right neurotransmitters, and must be "interconnected" with literally thousands of other neurons. Harvard's Ernst Mayr correctly remarked: "The unique character of our brain seems to lie in the existence of many (perhaps as many as forty) different types of neurons, some perhaps specifically human" (2001, p. 252, parenthetical item in orig.).

Also, a rich supply of oxygenated blood must be present, which would entail allowing additional blood vessels to reach these new neurons. Additionally, our brains require a tremendous amount of energy. As an example, a newborn's brain consumes 60% of the energy that the baby produces (Gibbons, 1998, p. 1345), while adults devote only 20% of their cardiac output to this organ (which only accounts for two percent of our body weight—Van De Graaf and Fox, 1989, p. 438). So the question then becomes, if humans (and their brains) evolved, why would nature "select" for a larger brain that is more energy consuming? Michael Ruse realized the hurdle in "evolving" brains when he stated: "When we developed brains, they are so expensive to produce that one needs really big ones or their benefits do not outweigh their costs" (2001a, p. 70). Furthermore, the question must be asked: Where does the energy come from in the first place? It would make sense that supporting a "bigger" brain would require a higher energy consumption, yet a human's basal metabolic rate is no higher than that of a large sheep, which has a brain one-fifth as large. As Gibbons noted: "Humans are apparently getting enough energy to feed their brains without increasing their overall energy intake, so it must be coming from some other source" (1998, p. 1345). But exactly what that source is, remains to be determined.

Researchers have long known that an animal's body size plays a critical role in brain size (see Gibbons, 1998, p. 1345). Whales and elephants compensate for their large brains by an increased size in other organs that can provide energy (e.g., larger heart and lungs provide more oxygen). But humans do not follow this rule. In the context of simian primates, for example, the human brain is approximately "three times larger than the value predicted for an 'average' monkey or ape with our body size" (Jones, et al., 1999, p. 116). If evolutionists are correct, then the human brain has tripled in size since "Lucy" walked the Earth, yet our bodies have yet to even double. According to primatologist Robert D. Martin, humans "have the largest brain size relative to body size among placental mammals" (as quoted in Gibbons, p. 1345). Yet, as Mayr has admitted:

> *What is perhaps most astonishing is the fact that the human brain seems not have changed one single bit since the first appearance of Homo sapiens, some 150,000 years ago.* The cultural rise of the human species from primitive hunter-gatherer to agriculture and city civilizations took place without an appreciable increase in brain size. It seems that in an enlarged, more complex society, a bigger brain is no longer rewarded with a reproductive advantage (2001, p. 25).

One question that evolutionists admittedly have difficulty answering is why "other animals" have not similarly "evolved" larger brains. If humans were able to somehow surmount all of the physiological and energy-related obstacles standing in the way of growing larger brains, why have reptiles, birds, or fish not followed suit? Exactly how is our brain different from those of animals? Was it forced to grow larger and "rewire" as we climbed out of trees and changed our diets? Hardly! Evolutionists admit that "our brain is unusually large" and that "its internal wiring shows only subtle differences from other mammals" (Jones et al., 1999, p. 107). But if the wiring is essentially the same, and if we know of animals that have larger brains, then what accounts for the vast differences we see between human intelligence and animal intelligence?

Equally important, of course (at least from the human vantage point) is the question: What caused the tremendous increase in *human* brain size? Scientists admit that no one knows. Johanson and Edgar wrote: "*We cannot answer exactly why we evolved our large brains*" (1996, p. 80). Ornstein admitted:

> *We look at whether the human mind is, in part, an accident. Its evolution turns around a central question: Why is our brain so big?* Why have a brain capable of not only chess when there was no game, but of building guided missiles when there was no metal or chemistry or writing? For the brain (which is the most "costly" neural material in the body) ballooned up radically 2 million years ago, and the "usual suspects" for this expansion don't seem to have primary responsibility. It was not language, it was not tools, it was not bipedalism alone. *The brain seems to have increased in size before all the organized societies, cooperation, and language would have had any call for such a development.*
>
> *This is the central mystery of the mind*: It is difficult to see why we are so advanced relative to our nearest ancestors. We aren't just a slightly better chimp, and it's difficult, on reflection, to figure out why. This gigantic cortex has given us our adaptability as well as the extra capacity to adapt to the heights of the Himalayas, the Sahara Desert, the wilds of Borneo, even to central London….
>
> Life challenges alone were probably not enough to inspire the astonishing rapidity of brain growth. *There must have been another reason*…. This development occurred well before organized society or language and long before technology. It is an amazing spurt in growth in the most complicated structure in all biology (1991, pp. 8,37, parenthetical item in orig.).

But was it the brain's size alone that allowed these "non-adaptive side consequences"? Apparently not, as Johanson and Edgar went on to note.

> In absolute size, the human brain breaks no records. Elephant brains exceed ours by a factor of four, and some whale brains are even bigger…. Monkeys, apes, and humans possess the biggest brains relative to body weight of any terrestrial mammal. So, part of the answer is that the human brain is just a highly elaborated ape brain. Yet this is still something different, something unique, about the size of the human brain. Our brain is three times larger than the predicted size for a hypothetical non-human primate of average body size…. *But size isn't everything.* Our brain also differs significantly from those of apes in the proportion of various parts…. The human brain is a sponge that soaks up sensations and observations, and it is a masterful organ for storing, retrieving, and processing a wide range of detailed and complicated information…. So, *size alone does not explain our unusual mental abilities.* What counts is what's inside the package and how it is all arranged… (p. 80).

Earlier, we quoted Ian Tattersall, who ended his assessment of the brain with these words: "There's a huge amount, of course, that we do not know about how the brain works and especially about how a mass of chemical and electrical signals can give rise to such complex effects as cognition and consciousness" (1998, p. 70). We also quoted Richard Morris, who lamented:

> Scientific knowledge of the brain is woefully incomplete. *Scientists do not know how the brain acquires and stores information, how it produces feelings of pleasure and pain, or how it creates consciousness. The functioning of the human brain is a profound mystery* (2001, p. 200).

We could not have said it better ourselves. Evolutionists do not know how the brain evolved. Nor do they have much understanding about how the brain acquires and stores information, in spite of decades of intensive research. Ernst Mayr admitted: "The synapses, for instance, apparently play an important role in memory retention, but how they do so is almost entirely unknown" (2001, p. 252). Similarly, evolutionists do not know how the brain creates consciousness. Yet the leading candidate to serve as a potential evolutionary explanation for the mind (and then, ultimately, consciousness) is, perhaps somewhat conspicuously, the brain. Some (like Pinker and his colleagues) believe that the brain evolved its specific regions with a purpose (if you will pardon the pun) "in mind." Others, like Gould and his followers, believe that, to quote Ornstein, "structures that evolved for one purpose later changed their function" and gave rise to consciousness (1991, p. 33). Not much agreement here, to be sure.

But there is one place where a consensus *does* exist. Monroe Strickberger, in his textbook, *Evolution*, put it like this: "[A]lthough we do not yet know the precise relationship between the matter of the brain (neurons, synapses, and so on) and the thoughts and feelings it produces, *that such a relationship exists is no mystery*" (2000, p. 56, parenthetical item in orig.). *That* a relationship between brain, mind, and consciousness exists may be "no mystery." But *why* and *how* that relationship exists, certainly *is*!

Perhaps it is because of the mystery that surrounds the various functions and attributes of the brain that, as our knowledge of the brain has multiplied in what sometimes seems to be almost a geometric progression, it has becoming increasingly popular to "downplay" the extreme complexity of the brain itself—no doubt in the hope that the general populace will begin to think like this: "Well, if the once-impenetrable fortress of humanity that is the human brain has now been breached and explained by science, we have answered the most basic issue: evolution's major problem is solved!" Attempts to minimize the brain's amazing abilities have become rather commonplace. Consider just one example.

In an article on mind/body problems titled "The Power of Mood" that he authored for the January 20, 2003 issue of *Time* magazine, Michael D. Lemonick commented:

> *The brain, after all, is only another organ*, and it operates on the same biochemical principles as the thyroid or the spleen. What we experience as feelings, good or bad, are at the cellular level no more than a complex interaction of chemicals and electrical activity (2003a, p. 66).

In the introductory article ("Your Mind, Your Body") he wrote to accompany the feature articles in that same issue of *Time*, he suggested:

> *Mind and body, psychologists and neurologists now agree, aren't that different.* The brain is just another organ, albeit more intricate than the rest.... Scientists are also learning something else. Not only is the mind like the rest of the body, but the well-being of one is intimately intertwined with that of the other. *This makes sense because they share the same systems*—nervous, circulatory, endocrine and immune (2003b, p. 63).

Russell Stannard, in his volume, *The God Experiment: Can Science Prove the Existence of God?*, wrote:

> It is a widely held assumption that nothing goes on in the brain that is markedly different from what happens in inanimate matter. Although the processes occurring in the brain are undoubtedly more intricate because of the extreme complexity of the physical structure, *they are nevertheless all to be held accountable for—in principle—through the operation of the well-established laws of nature* (2000, p. 45).

Tufts University philosopher Daniel Dennett, in an interview on this very subject, said matter-of-factly: "The mind is somehow nothing but a physical phenomenon. *In short, the mind is the brain*..." (as quoted in Lewin, 1992, p. 157). Sherwin Nuland, in *The Wisdom of the Body*, took the same approach.

> *The mind is a man-made concept*, a way to categorize and contemplate the manifestations of certain physical and chemical actions that occur chiefly in the brain. It is a product of anatomic development and physiologic functioning. What we call the mind is an activity, made up of a totality of the innumerable constituent activities of which it is composed, brought to awareness by the brain. The brain is the chief organ of the mind, but not its only one. In a sense, every cell and molecule in the body is a part of the mind, and every organ contributes to it. *The living body and its mind are one—the mind is a property of the body* (1997, p. 349).

In *The Astonishing Hypothesis*, Francis Crick even went so far as to suggest that it soon may be possible to identify specific neurons in the brain that cause consciousness. He asserted that, eventually, all mind processes, including consciousness, will be explicable as nothing more than the firing of neurons—i.e., in terms of interactions between atoms and molecules (1994, pp. 3,259). Steven Pinker is on record as stating: "*Nothing in the mind exists except as neural activity*" (1997b). B.A. Farrel announced bluntly: "A human being is a modulator of pulse frequencies, and nothing more" (as quoted in Allan, 1989, p. 63). Or, as Jerome Elbert put it: "I DO maintain that 'mental events can be reduced to brain events'" (2000, p. 265). He then predicted:

> Science will probably succeed in describing how our consciousness arises from natural processes. It will probably explain how thinking, reasoning, emotions, motivations, and intuition function as a result of the activity of the brain, and as a result of the brain interacting with the

> rest of the body and the outside world (p. 268).

Think with us for a moment, however, about the implications of what you have just read. Beliefs have consequences! If: (a) "what we experience as feelings, good or bad, are at the cellular level no more than a complex interaction of chemicals and electrical activity"; (b) "mind and body…aren't that different"; (c) "the mind is a property of the body" and "mind is a man-made concept"; (d) "nothing in the mind exists except as neural activity," *what does all of this mean*?

Let Steven Pinker explain. He believes (as noted above) that "nothing in the mind exists except as neural activity." Would it surprise you to learn, then, that in a *New York Times* article, Pinker suggested that women who murder their newborn babies may not be either mad or evil, but simply unconsciously obeying "primeval instincts to sacrifice their children for the good of the tribe"? (see Blanchard, 2000, p. 382). In his fascinating book, *Does God Believe in Atheists?*, John Blanchard addressed Dr. Pinker's suggestion: "This is the logical outworking of materialism, BUT IF REDUCING THE BRAIN'S ACTIVITY TO ELECTRICAL IMPULSES CAN SANCTION MURDER, WHAT CAN IT CONDEMN?" (p. 382)

What indeed? Atheistic philosopher Michael Ruse admitted that if evolution is accepted as true, then "*morality is no more…than an adaptation*, and as such has the same status as such things as teeth and eyes and noses" (1995, p. 241). But if, as Ruse went on to say, "morality is a creation of the genes" (p. 290), then by what criterion, or group of criteria, do humans make moral decisions? Reichenbach and Anderson commented on this very issue when they wrote:

> Reductionism, however, threatens the very concept of the person. Where persons' actions and beliefs are ultimately explainable in terms of unpredictable neural firings and chemical transfers, those acts and beliefs are no longer the purposeful product of human choice…. *This means that reductionism is particularly disastrous for morality, not to mention our concept of personhood itself* (1995, p. 279).

And what place is there for the famed human possession, "free will"? Are we merely products of our environment? Does input truly equal output? Nancey Murphy recognized the quandary of losing our free will and reducing the brain to little more than matter.

> First, if mental effects can be reduced to brain events, and the brain events are governed by the laws of neurology (and ultimately by the laws of physics), then in what sense can we say that humans have free will? Are not their intendings and willings simply a product of blind physical forces, and thus are not their willed actions merely the product of the blind forces? (1998, p. 131).

She went on to comment:

> Second, if mental events are simply the products of neurological causes, then what sense can we make of reasons? That is, we give reasons for judgments in all area of our intellectual lives—moral, aesthetic, scientific, mathematical. It seems utter nonsense to say that these judgments are merely the result of the blind forces of nature (p. 131).

Have we no option but to do whatever our genes have programmed us to do? In other words, how can the materialist escape from the stranglehold of determinism—the idea which suggests, as its name implies, that everything we do is "determined," and that we have, in essence, no free will. This farcical idea is exactly what Cornell professor William Provine has advocated. In 1998, during "Darwin Day" at the University of Tennessee at Knoxville, he delivered the keynote lecture titled "Evolution: Free Will and Punishment and Meaning in Life." During that lecture, he displayed a slide that stated: "Finally, free will is nonexistent." It went on to note: "Free will is the worst of all cultural inventions. Belief in free will fuels our revenge-minded culture" (see Provine, 1998).

In the now-famous text of his Compton Lectures, *Objective Knowledge: An Evolutionary Approach*, British philosopher Sir Karl Popper made the point that even if determinism *were* true, it could not be argued, since any argument is itself presumably predetermined by purely physical conditions—as would be any opposing arguments. As Popper put it:

> According to determinism, any such theories—such as, say, determinism—are held because of a certain physical structure of the holder (perhaps of his brain). Accordingly, we are deceiving ourselves (and are physically so determined as to deceive ourselves) whenever we believe that there are such things as arguments or reasons which make us accept determinism. Or in other words, physical determinism is a theory which, if it is true, is not arguable, since it must explain all our reactions, including what appear to us as beliefs based on arguments, as due to *purely physical conditions*. Purely physical conditions, including our physical environment, make us say or accept whatever we say or accept… (1972, p. 223).

In their book, *The Wonder of Being Human: Our Brain and Our Mind*, Sir John Eccles and his co-author Daniel Robinson commented on the correctness of Popper's assessment—and the absurd nature—of determinism when they observed: "This is an effective *reductio ad absurdum*" [reduction to the absurd]. They then went on to state: "This stricture applies to all of the materialist theories"

(1984, p. 38; cf. also Eccles, 1992, p. 21). Indeed, it *is* absurd. And yes, it *does* apply to "all of the materialist theories."

A good illustration of this is the life, teachings, and actions of the French novelist commonly known as the Marquis de Sade (1740–1814), who gave his name to sadism, in which a person derives sexual satisfaction from inflicting pain and humiliation on others. De Sade argued that, since everything is chemically determined, whatever is, is right. The distinguished microbiologist, Lynn Margulis, and her co-author/son Dorion Sagan, discussed this very point in their book, *What is Life?*

> The high-born Frenchman Donatien Alphonse Francois de Sade (1740–1814) keenly felt the vanishing basis for morality. *If Nature was a self-perpetuating machine and no longer a purveyor of divine authority, then it did not matter what he, as the infamous marquis de Sade, did or wrote* (1995, p. 40).

Or, as Ravi Zacharias put it: "Thinking atoms discussing morality is absurd" (1990, p. 138).

In his book, *In the Blood: God, Genes and Destiny*, Steve Jones suggested that criminal behavior was determined largely by genetic make-up (1996, pp. 207–220). In discussing Jones' book, one writer, Janet Daley, insisted that if genetics is indeed ultimately responsible for "bad" traits, it also must account for "good" ones. She observed: "If we can never be truly guilty, then we can never be truly virtuous either." Daley went on to say:

> Human beings are only capable of being moral insofar as they are free to choose how they behave. If they have no power to make real choices—if their freedom to decide how to act is severely limited by forces outside their control—then it is nonsense to make any ethical judgements about them. It would be wrong, as well, to base a judicial system on the assumption that people are free to choose how they will act. The idea of putting anyone on trial for anything at all becomes absurd (1996).

In fact, attempting to locate a "basis for morality" in the blind outworkings of nature is futile. As Ruse put it: "There is no justification for morality in the ultimate sense" (as quoted in O'Hear, 1997, p. 140). In Dave Hunt's words, "There are no morals in nature. Try to find a compassionate crow or an honest eagle—or a sympathetic hurricane" (1996, p. 41). Are those who advocate the idea that "nothing in the mind exists except as neural activity," willing to accept the consequences of their belief?

Growing Neurons

Every human begins life as a single fertilized cell. When the male and female gametes join to form the zygote that eventually will grow into the fetus, it is at that very moment that the formation of a new body begins. It is the result of a *viable* male gamete joined sexually with a *viable* female gamete, which has formed a zygote that will move through a variety of important stages.

The first step in the process—which eventually will result in the highly differentiated tissues and organs that compose the body of the neonatal child—is the initial mitotic cleavage of that primal cell, the zygote. At this point, the genetic material doubles, matching copies of the chromosomes move to opposite poles, and the cell cleaves into two daughter cells. Shortly afterwards, each of these cells divides again, forming the embryo. [In humans and animals, the term "embryo" applies to any stage after cleavage but before birth (see Rudin, 1997, p. 125).]

As the cells of the embryo continue to divide, they form a cluster of cells. These divisions are accompanied by additional changes that produce a hollow, fluid-filled cavity inside the ball, which now is a one-layer-thick grouping of cells known as a blastula. Early on the second day after fertilization, the embryo undergoes a process known as gastrulation, in which the single-layer blastula turns into a three-layered gastrula consisting of ectoderm, mesoderm, and endoderm, surrounding a cavity known as the archenteron. Each of these layers will give rise to very specific structures. For example, the ectoderm will form the outermost layer of the skin and other structures, including the sense organs, parts of the skeleton, and the nervous system. The mesoderm will form tissues associated with support, movement, transport, reproduction, and excretion (i.e., muscle, bone, cartilage, blood, heart, blood vessels, gonads, and kidneys). The endoderm will produce structures associated with breathing and digestion (including the lungs, liver, pancreas, and other digestive glands) [see Wallace, 1975, p. 187].

Within 72 hours after fertilization, the embryo will have divided a total of four times, and will consist of sixteen cells. Each cell will divide before it reaches the size of the cell that produced it; hence, the cells will become progressively smaller with each division. About twenty-two days after fertilization, the brain begins its embryonic development with the formation of the neural tube. About twenty-two days after fertilization, this hollow region begins to develop (Moore and Persaud, 1993, p. 385). The cells located within this hollow tube eventually will multiply, migrate, and become the brain and spinal cord. Once the brain is fully developed, three distinct regions can be identified: forebrain, midbrain, and hindbrain. Structures such as the cerebrum, thalamus, and hypothalamus are located within the forebrain. The midbrain is made up of the superior and inferior colliculi and the cerebral peduncles.

The hindbrain is composed primarily of the cerebellum, pons, and medulla oblongata. Literally millions of neurons are housed in each of these structures, from which radiate communicating axons to other regions to allow the entire brain the unique ability to communicate with itself (thanks to a small structure known as the corpus callosum, the left and right hemispheres of the brain possess the ability to communicate with one another).

While regions and structures within the brain have been dissected exhaustively and mapped out considerably, what can those neurological pathways tell us about *function*? Can we look at the exterior surface of the brain and determine the intellectual capabilities of an individual? Evolutionists must think so; look at the "dumb," hairy, club-carrying creatures that they portray as our ancestors. These evolutionists would like to be able to look at a fossilized skull, or even an endocranial cast, and determine what "prehuman" brains were capable of doing in the distant past. However, as Terrence Deacon admitted: "Surface morphology and underlying brain functions are not directly correlated in most cases." He went on to say, therefore, that "we must be careful when drawing functional interpretations from endocasts" (1999, p. 116).

Many materialists are adamant that the human brain has evolved through a layering process—with each "higher species" adding a new layer. Thus, as Ian Tattersall remarked in his book, *The Monkey in the Mirror*, "as far as is known, not much if anything has been 'lost' in the course of human brain evolution. Our skulls still house the descendants of structures that eons ago governed the behavior of ancient fish, of primitive mammals, and of early primates" (2002, p. 72).

According to this "triune" brain theory, the brain evolved in three stages: the reptilian brain, followed by the paloecortex, and then the neocortex. Thus, the innermost portion of our brain is said to be the reptilian brain—since evolutionists believe it to be the oldest and most primitive portion. It therefore would include structures such as the pons and medulla, and would handle many of the autonomic tasks needed for survival (e.g., breathing). According to evolutionists, this portion of our brain has remained basically unchanged by evolution, and we therefore share it with all animals that possess a backbone. The next layer is said to be the mammalian brain or the paloecortex, which is alleged to have arisen when mammals evolved from reptiles. It would include structures such as the amygdale and hypothalamus. Then, on top of this, evolutionists claim we have added another layer—the neocortex or human brain, which allows humans to handle logic. This new layer is said to "envelop" the other layers in gray matter, and amounts to 85% of the human brain mass. In his biography of Carl Sagan, William Poundstone observed that even Sagan propagated this myth. He noted: "His extended discussion of the triune brain implicitly endorses it as (at least) an interesting idea. That was what some neurologists found objectionable. 'It's dismaying for people like us,' complained Boyd Campbell of Walter Reed Army Medical Center, 'to see Sagan come and swallow all that stuff, write *The Dragon of Eden*, and get a Pulitzer Prize for it'" (1999, p. 254, parenthetical item in orig.). Dismaying indeed. As James Trefil pointed out, this way of thinking is "completely wrong:"

> Unfortunately, this understanding of the brain has led to a rather oversimplified notion of brain function in some parts of the popular press—in which the brain is seen as a set of successive overlays. At the bottom (the brain stem and diencephalons) is a kind of primitive, reptilian brain shared with all animals, with progressive overlying refinements added until we get to the cerebral cortex, which reflects the highest brain functions. In its extreme form, this view presents the idea of the brain as a kind of sedimentary structure, like the stratifications of the Grand Canyon. Each new layer adds a new function, while underlying layers stay more or less the same. This is another of those concepts that the French call a *fausse idée claire. It's simple, elegant, clear, and completely wrong* (1997, p. 75, parenthetical item in orig.).

And yet the textbooks still show a progression through fish, amphibians, reptiles, and mammals. This theory of how the brain evolved in layers has suffered the same fate as that of a soufflé when the oven door is slammed—it has fallen flat.

The Brain Versus a Computer

Walk into any office, hospital, or even grocery store, and you will find yourself in the presence of computers. Computers have become an integral part of everyday life—they even played a part in getting this article to you. But most intelligent individuals will agree that computers did not arrive on this planet by time, natural law, and chance. Computers are designed and manufactured, and they constantly are being improved to increase their speed and capabilities. But the computer fails miserably in comparison to the human brain. When is the last time a computer grabbed a pencil to compose a sonnet, a short story, or a poem? How many computers are capable of taking a piece of wood, fashioning it in the shape of a violin, and then sitting down to play Barber's *Adagio for Strings*. And yet evolutionists insist that the human brain—an object far more complex, and with far more capabilities than a com-

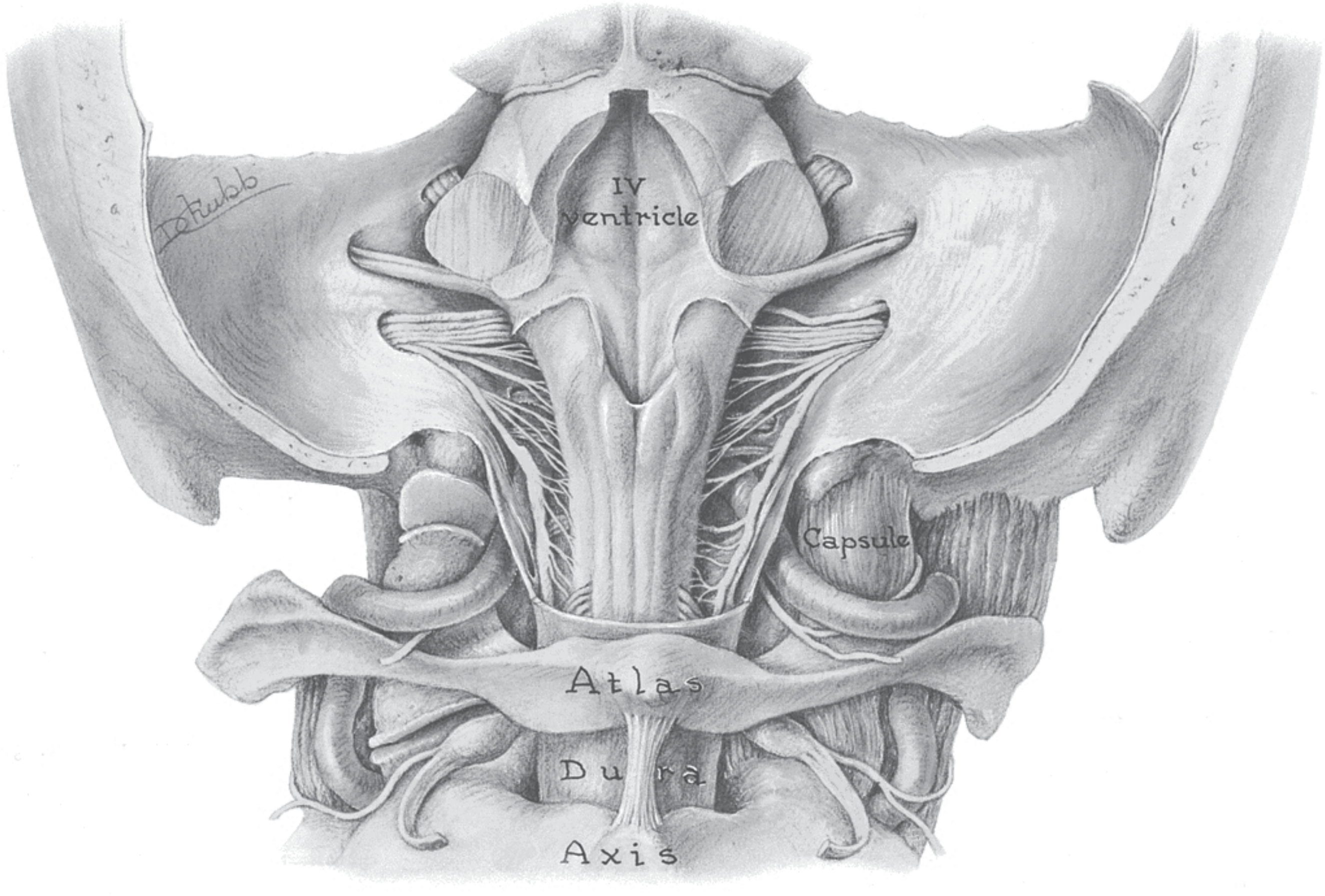

Figure 4: Posterior view of cranial nerves exiting through various foraminae. LifeART image copyright (2003) Lippincott Williams & Wilkins. All rights reserved.

puter—"evolved" in order to provide us with memories, emotions, the ability to reason, and the ability to talk. Other individuals like to "simplify" the human brain down to the level of modern-day computers. They rationalize that, like computers, the human brain can rapidly process, store, and recall bits of information. Also, some scientific investigators compare neuronal connections to the wiring found within computers. However, the inner workings of a computer always can be reduced to one thing—electronics. The basic function of computers always involves the movement of an electrical charge in a semiconductor. The brain, on the other hand, operates purely on electrochemical reactions. The transmission of nerve signals involves chemicals known as neurotransmitters. Once a neuron is caused to fire, it moves these neurotransmitters into the tiny space between itself and the neighboring neurons (at the synapse), in order to stimulate them.

Additionally we know that the human brain can reason and think—i.e., we possess self-awareness. Computers have the ability to carry out multiple tasks, and they can even carry out complex processes—but not without the programming and instruction they receive from humans. Additionally, computers do not possess the ability to reason. When asked to translate into Russian the sentence—"the spirit is willing but the flesh is weak"—one computer came up with words that meant "the vodka is fine, but the meat is tasteless" (Allan, 1989, p. 68)—which is a far cry from the original meaning. Nor are computers self-aware. In comparing a modern-day computer to the awesome power of the human brain, astrophysicist Robert Jastrow admitted: "The machine would be a prodigious artificial intelligence, but it would be only a clumsy imitation of the human brain" (1981, p. 143).

It has been estimated that if we learned something new every second of our lives, it would take three million years to exhaust the capacity of the human brain (Weiss, 1990, p. 103). Plainly put, the brain is not just an advanced computer. All those convolutions and neuronal networks are

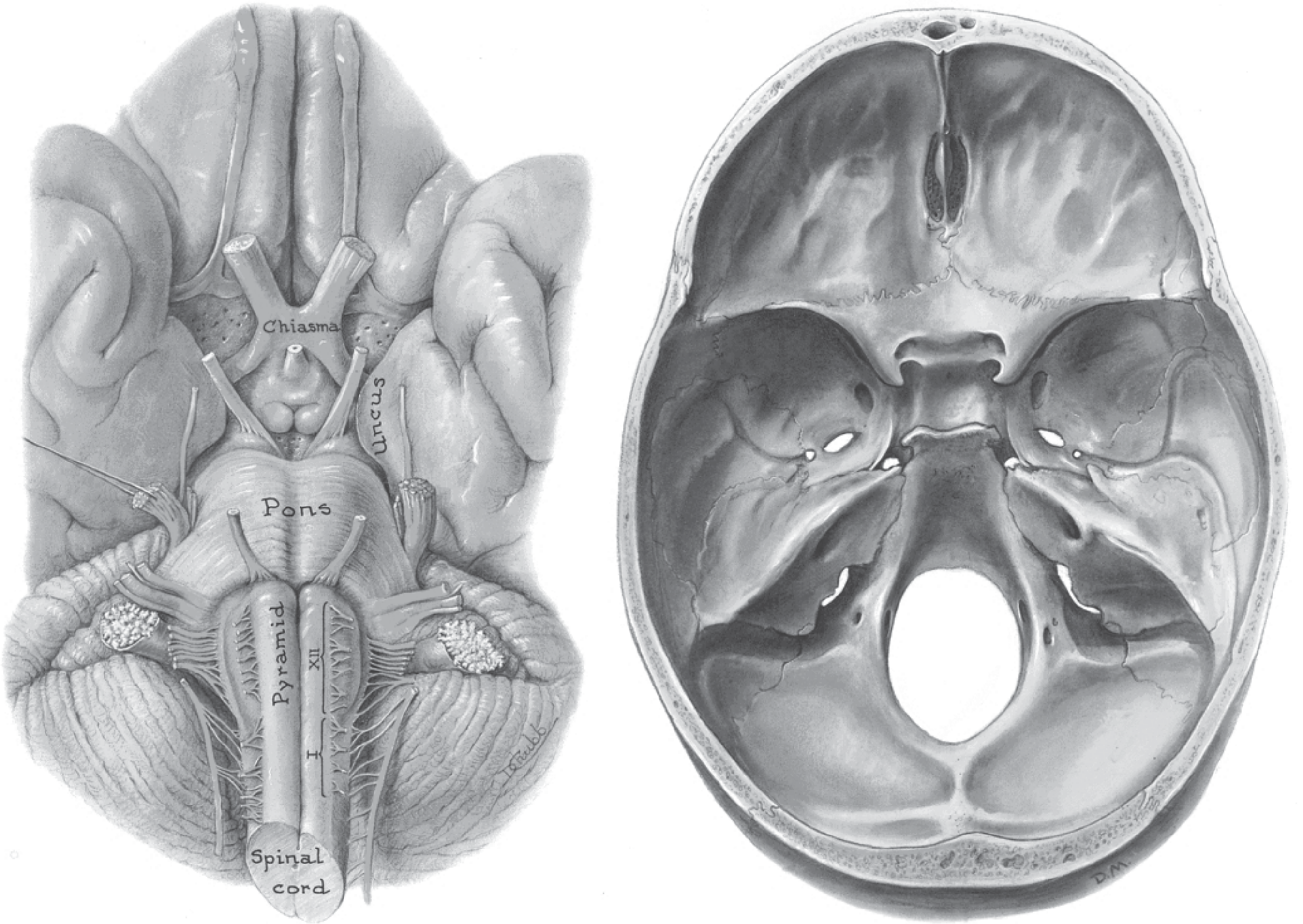

Figure 5: Superficial view of cranial nerves and the interior base of the skull demonstrating the various formina. LifeART image copyright (2003) Lippincott Williams & Wilkins. All rights reserved.

the result of an intelligent Creator. If we are able to rationalize that a computer found in the middle of the Sahara Desert did not just "happen" by random chance, then why are so many willing to believe that a far more complex human brain occurred in such a fashion?

Twelve Cranial Nerves

We all have experienced the unpleasantness of sitting in front of a doctor with our tongue outstretched, saying "Ah," while the physician gags us with a wooden tongue depressor. Interestingly, this dreadful routine, which is performed on a daily basis in clinics and doctors' offices around the world, has a purpose. By having you open your mouth, protrude your tongue, vocalize the word "Ah," and confirm an intact gag reflex, doctors are able to not only look at the back of your throat, but also to assess many of your cranial nerves. Every human is born with twelve pairs of these special nerves, each performing a different function, and each going to a different location within the body.

Unlike nerves that originate from your spinal cord, cranial nerves drop directly out of the brain and then proceed to their target organs. Recall, however, that your brain is completely encased in bone—your skull. So, exactly how do these twelve cranial nerves get to where they need to go? Quite simply, they travel through well-placed foramena or "holes." Each pair of nerves has a specific "hole" through which it descends in order to reach a target such as the eye (optic nerve) or the heart (vagus nerve). If you were to take a skull and pour water where the brain normally would be sitting, you soon would notice water coming out of several different holes. These holes allow the cranial nerves to travel from the brain to their target organs. But ask yourself this question: How did the holes get there? Did they evolve, too? Did these cranial nerves simply "evolve" out of the brain and then wait around until holes evolved in the skull? And let us not make a small issue out of these tiny holes: the brain is constantly bathed in cerebral spinal fluid, a fluid that you do not want "leaking" out of the cranium. The formation of the holes and the dural layers that prevent this "leakage" definitely point to an intelligent Creator.

Conclusion

Neuroscientists already have gone, to use the Star Trek mantra, "where no one has gone before." Scientists now possess the ability to record the neurological activity from a single neuron. Using ultra-fine microelectrodes, we can proceed down through the cortex of the brain and patch-clamp neurons in order to determine exactly what ionic changes are occurring across the neuronal membranes. We have the ability to use tracer dyes to detect where a nerve sends a specific signal. Entire maps have been made that demonstrate the neurological pathways of specific types of neurons. We have tremendous hope that new areas of research, such as neuronal stem cells and nerve growth factors, will relieve or cure some of the neurological diseases that exist today. But science is far from understanding and comprehending the complexity of the brain. In fact, the brain remains a puzzle with far more pieces missing than have been properly set in place to complete the puzzle.

Upon hearing of the death of a child, a mother will begin to weep uncontrollably. What actually caused the tears to flow down her face? Where does she hold those treasured memories of her offspring? Some scientists would have us believe that those tears are merely a product of organic evolution, and that through time, humans "naturally selected" for them. But why? Man can reason, laugh, cry, and even worship. Why would we selectively want to cry at the loss of a loved one? Or why would our fleshly "brain" go to great lengths to worship and praise something it has never seen—unless we are more than mere matter? Evolutionist Steven Pinker wrestled with this point in his book, *How the Mind Works*.

> How does religion fit into a mind that one might have thought was designed to reject the palpably not true? The common answer—that people take comfort in the thought of a benevolent Shepherd, a universal plan, or an afterlife—is unsatisfying, because it only raises the question of why a mind would evolve to find comfort in beliefs it can plainly see are false. A freezing person finds no comfort in believing he is warm; a person face-to-face with a lion is not put at ease by the conviction that it is a rabbit (1997a, pp. 554–555).

The precision and complexity of our brain, and the manner in which it is able to interact with our mind, clearly point to an Almighty Creator. How can we look at something as marvelous as the human brain—something that we have yet to unravel all the mysteries of—and suggest that it is the end product of a cosmological accident? God formed man with intelligence literally from the first day of creation. How sad is it that man is now using this God-given intelligence to eradicate any mention of a Divine Creator? Writing in the *Bulletin of Atomic Scientists*, professor Roger Sperry, a psychologist at the California Institute of Technology, observed:

> Before science, man used to think himself a free agent possessing free will. Science gives us, instead, causal determinism wherein every act is seen to follow inevitably from preceding patterns of brain excitation. Where we used to see purpose and meaning in human behavior, science now shows us a complex bio-physical machine composed entirely of material elements, all of which obey inexorably the universal laws of physics and chemistry.… I find that my own conceptual working model of the brain leads to inferences that are in direct disagreement with many of the foregoing; especially I must take issue with that whole general materialistic-reductionist conception of human nature and mind that seems to emerge from the currently prevailing objective analytic approach in the brain-behaviour sciences. When we are led to favour the implications of modern materialism in opposition to older, more idealistic values in these and related matters, *I suspect that science may have sold society and itself a somewhat questionable bill of goods* (1966, pp. 2–3)

We suspect so, too.

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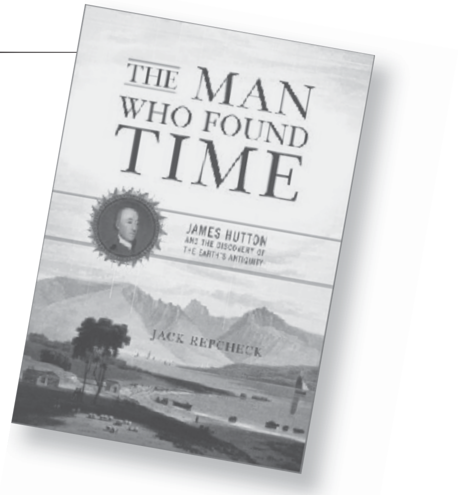
[Authors' Note: This article is an abbreviated discussion of this topic. A more complete treatment may be found in: Harrub, Brad and Bert Thompson. 2003. *The truth about human origins*. Apologetics Press, Montgomery, AL.]

Book Review

The Man Who Found Time by Jack Repcheck
Perseus Publishing, Cambridge, MA. 2003. $26.00



This is the story of Scottish James Hutton (1726–1797) who along with Charles Lyell (1797–1875) and Charles Darwin (1809–1882) helped overthrow in the minds of many the belief in a biblically-based, young Earth creation. Repcheck's thorough review of the historical aspects of the controversy is well worth reading. He shows how gradually through time bits and pieces of the Creation story were cast aside. The reasons were manifold. Some were clearly due to faulty theology of the Church at the time – the Earth is the center of the universe, hence all the heavenly bodies revolve around it, the Genesis "kinds" are the same as the modern-day biological classification of "species," etc. On the other hand, Hutton's idea of an ancient Earth with "no vestige of a beginning—no prospect of an end" was squarely founded upon his personal observations of slow erosion rates. This idea begot the huge assumption of slow geologic rates throughout the entire Earth's history. Divine intervention was not allowed. Hence, it was impossible to conceive of the Earth as being young, in spite of it being so pictured in biblical genealogies.

While more modern geology thought admits that catastrophes did, in fact, occur during geologic history, the over-all belief in an ancient Earth still prevails. Indeed, with the discovery of radioisotopes about a hundred years after Hutton's death, the scientific community is confident that Hutton's over-all idea of an ancient Earth is sound. Obviously, this is the reason for young earth creationists to continue searching for possible ways in which radioactive decay rates may have been much higher in the geologic past, thus giving misleading, ancient dates based upon the assumption of uniform decay rates.

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Mind, Materialism, and Consciousness

Brad Harrub and Bert Thompson*

Abstract

Within academia, there is an urgency to provide some sort of purely materialistic explanation for both the mind and human consciousness. However, in reducing the mind to nothing more than neuronal firing patterns, science has placed itself in the unenviable position of having to explain why animals do not possess consciousness, since they share many of those same neuronal firing patterns. This paper investigates the mind, and whether or not animals possess consciousness. Our findings indicate that materialism is unable to explain the numerous important differences between humans and animals in regard to mind and consciousness. Rather, the capability of the human brain to network with the human mind, and the singularly unique human characteristic of consciousness, point forcefully to an intelligent Designer.

(Note: In this paper, SMALL CAPS indicate emphasis in original; *italics* indicate emphasis added. Words in [brackets] added by the authors.)

The Brain, the Mind, and Human Consciousness

We suspect that it hardly will come as any great shock for us to observe that, "somehow," brains, minds, and consciousness are viewed as "going together." Brains are "mysteriously" linked to minds. Paul Ehrlich commented: "[W]hen we think of brains, we ordinarily think of minds, just as when people think of legs they think of walking and running…." (2000, p. 109). True enough. And, as Colin McGinn opined: "There just HAS to be some explanation for how brains [interact with] minds" (1993, p. 6).

But minds, just as "mysteriously," are linked to consciousness. When we think of minds, we also think of consciousness, a fact that physicist Freeman Dyson of Princeton's Institute for Advanced Study discussed in his semi-autobiographical book, *Disturbing the Universe*.

> *It is remarkable that mind enters into our awareness of nature on two separate levels.* At the highest level, the level of human consciousness, our minds are somehow directly aware of the complicated flow of electrical and chemical patterns in our brains. At the lowest level, the level of single atoms and electrons, the mind of an observer is again involved in the description of events…. But I, as a physicist, cannot help suspecting that there is a logical connection between the two ways in which mind appears in my universe…. That is to say, *I think our consciousness is not just a passive epiphenomenon carried along by the chemical events in our brains, but is an active agent* forcing the molecular complexes to make choices between one quantum state and another (1979, p. 249).

The undeniable fact that brains are linked to minds, and that minds are linked to consciousness, has produced a true conundrum for evolutionists. As science writer James Trefil asked: "How can we go from a purely physical-chemical system such as the brain to something nonphysical such as our mental experience? What, in other words, is the connection between the firing of neuron 1,472,999,321 and my EXPERIENCE of seeing blue?" (1997, p. 180). In an "invited review" on the subject of consciousness that he was asked to write for the journal, *Brain*, Adam Zeman commented on what he referred to as "the current fascination with consciousness," and suggested that it "reflects the mounting intellectual pressure to explain how 'vital activity' in the brain generates a 'mental element' with rich subjective content" (2001, p. 1284).

There is indeed "mounting intellectual pressure" to explain the brain's "vital activity," which somehow generates the "mental element" we know as consciousness. After all, consciousness, we are assured, is "our most precious possession." Surely, that alone would serve to justify a serious and sustained investigation into the "rich subjective content" of human self-awareness.

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Materialism, Supernaturalism, and the Brain/Mind Connection

Truth be told, however, from an evolutionary perspective, the investigation is extremely self-delimiting. After all, evolution, by definition, is a naturalistic process. George Gaylord Simpson once noted: "Evolution is a *fully natural process*, inherent in the physical properties of the universe, by which life arose in the first place and by which all living things, past or present, have since developed, divergently and progressively" (1960, p. 969). If evolution is accepted as the correct explanation of human origins, and if evolution is a "fully natural process," then whatever exists *must* be the result of purely naturalistic processes. In short, to paraphrase McGinn, "there just *has* to be" some *naturalistic* explanation for how the brain produces the mind, and for how the mind, in turn, produces consciousness. As Christopher Wills wrote in his volume, *Children of Prometheus*: "[T]he human brain is the most remarkable product of evolution to be found among the Earth's living organisms" (1998, pp. 228–229). Ehrlich similarly concluded: "Evolution is the key to the mind" (p. 109).

As you might expect, whatever the evolutionary explanation turns out to be for how the brain gave rise to the mind, and how the mind then gave rise to consciousness, *material causes ultimately were responsible*; *nothing supernatural was involved*! As Heinberg noted:

> But if the existence of purpose in organisms is problematic for the purely mechanistic explanation of life—and for the more general philosophy of MATERIALISM, which holds that all observable phenomena are explainable as the results of material causes—consciousness is doubly so…. Understandably, *reductionist and materialist science—which is at war with theistic philosophies and features a non-physical God at the center of cosmos and creation—has therefore sought to find purely physical, chemical explanations for consciousness in humans and other creatures* (1999, p. 68).

It should not surprise us, then, to see evolutionist Andrew Brown, writing in *The Darwin Wars*, state: "All working biologists agree that intelligence, curiosity, free will and so on are produced by the normal, law-bound mechanical processes of the world" (1999, p. 154). James Trefil observed in *101 Things You Don't Know about Science and No One Else Does Either*: "Let me define materialism as the belief that the brain is a physical system governed by knowable laws of nature, and that *every phenomenon (including mental phenomena) can ultimately be explained in this way*" (1996, pp. 187–188). Elbert remarked in *Are Souls Real?*:

> The brain is all that is needed for consciousness…. Modern knowledge of the brain and CONSCIOUSNESS SUPPORTS THE IDEA THAT CONSCIOUSNESS RESULTS FROM THE OPERATION OF THE CENTRAL NERVOUS SYSTEM, ESPECIALLY THE BRAIN. Nothing else seems to be needed to generate consciousness…. In my opinion, there is NO GOOD REASON TO BELIEVE THAT THE MIND NEEDS A SUPERNATURAL EXPLANATION (2000, pp. 222, 249, 255).

Donald Griffin (of animal-consciousness fame) was equally blunt in his assessment.

> I will take it for granted that behavior and consciousness (human and nonhuman) result entirely from events that occur in their central nervous systems. In other words, *I will proceed on the basis of emergent materialism*, and assume that subjective consciousness is an activity of central nervous systems, which are of course part of the physical universe. Just what sort of neural activity leads to consciousness remains a challenging mystery,…but *there is no need to call upon immaterial, vitalistic, or supernatural processes to explain how some fraction of human or animal brain activity results in conscious, subjective thoughts and feelings* (2001, p. 5, parenthetical item in orig.).

Neurophysiologist and Nobel laureate Ragnar Granit, in an article on "Reflections on the Evolution of the Mind and Environment," admitted: "Like so many other biologists, I think of mind or conscious awareness as an emergent property in the evolution of life. This implies that it exists *in nuce* [necessarily] in properties of matter, just as does the insulin molecule or the double helix containing DNA" (1982, p. 97).

Richard Gregory, in his discussion on "Consciousness" in *The Encyclopaedia of Ignorance*, suggested that when it comes to the appeal to the supernatural, "there is no such evidence BETWEEN brains, and no evidence WITHIN brains, for non-physical causes" (1977, p. 277). Francis Crick, in *The Astonishing Hypothesis*, provided what may well be the most complete and well-thought-out statement of the scientific materialists' view of the human brain ever to be put into print.

> You, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules. As Lewis Carroll's Alice might have phrased it: "You are nothing but a packet of neurons" (1994, p. 3).

Or, as Robert Wesson put it in *Beyond Natural Selection*: "The mind is no more independent of the body than living creatures are independent of their physiology" (1997, p. 277). E.O. Wilson intoned: "Virtually all contemporary scientists and philosophers expert on the subject agree that the mind, which comprises consciousness and rational process, is the brain at work" (1998, p. 98).

The Concept of Mind

Evolutionists speak effusively of an individual cell as containing "previously unimagined complexity and dynamism" (Koch, 1997, p. 207), and the brain (which is composed of between 10 and 100 billion cells!) as being "the most developed and complex system known to science" (Davies, 1992, p. 4). Whence has come the "amazing complexity" that careens through the human body—from the individual cells to the master organ, the brain? And what part does it play in regard to the human mind and human consciousness?

On the one hand, evolutionists freely admit that, even at the cellular level, there is an "unimagined complexity and dynamism." Yet on the other hand, they expect us to believe that, ultimately, this has resulted from a disorganized bunch of macromolecules fortuitously coming together in a "just-so" fashion to produce not only the cell's (and the organism's) incredible intricacy, but also the human mind and its accompanying self-awareness. In fact, Daniel Dennett addressed this very point in *Kinds of Minds*. Speaking specifically about humanity's rise from macromolecules to cells to complete organisms that possess both minds and consciousness, he wrote:

> *These impersonal, unreflective, robotic, mindless little scraps of molecular machinery are the ultimate basis of all the agency, and hence meaning, and hence consciousness, in the world*. It is rare for such a solid and uncontroversial scientific fact to have such potent implications for structuring all subsequent debate about something as controversial and mysterious as minds, so let's pause to remind ourselves of these implications.
>
> *There is no longer any serious informed doubt about this: we are the direct descendants of these self-replicating robots* (1996, pp. 22–23).

The "alternatives" mentioned by Dennett are any concepts which suggest that something other than strict materialism may be at work (concepts that he, as a self-professed atheistic evolutionist, absolutely abhors). "So," said Dennett, "let's see what story can be told with the conservative resources of science. *Maybe the idea that our minds evolved from simpler minds is not so bad after all*" (p. 24).

Notice the progression allegedly involved in all of this. Macromolecules evolved into single-celled creatures, which evolved into multi-celled creatures, which eventually evolved into creatures with "simpler minds," which then evolved into—humans. And at the conclusion of that laborious and time-consuming process, how did the human mind turn out? Apparently, not very well, as Robert Ornstein forthrightly concluded:

> *The mind is a squadron of simpletons*. It is not unified, it is not rational, it is not well designed—or designed at all. *It just happened*, an accumulation of innovations of the organisms that lived before us…. *It is, basically, just another organ* to help a person operate in the world, to stay out of trouble, to eat, sleep, and reproduce. *So why should human beings ever have evolved the ability to know what their mental system is doing, any more than we know what our pancreas is doing? We have not done so. Our natural view of our mental state is deeply distorted* (1991, pp. 2, 7).

Now, let us see if we understand all of this correctly? Nonliving macromolecules gave rise to living cells, which then gave rise to organisms with "simpler minds," which then evolved into humans with minds that are "not unified, not rational, and not well designed," but instead are composed of "a squadron of simpletons." Admittedly, there is a "complicated internal system" with a "previously unimagined complexity and dynamism" that permits humans (and humans alone!) to possess self-awareness, use symbolic language, and be aware of the fact that they one day will die. But, in the end, the human mind "did not spring from a designer," and is "basically, just another organ."

The real truth of the matter is, while evolutionists fall all over themselves to avoid any possible hint that the human mind may have a supernatural origin (what Dennett referred to as a "desperate alternative"), they nevertheless cannot offer an adequate explanation for the concept of mind, or how it could have arisen from "chemical and electrical signals that give rise to such complex effects as cognition and consciousness." Renowned physiologist Sir Charles Sherrington remarked in his book, *Man on His Nature*: "A radical distinction has therefore arisen between life and mind. The former is an affair of chemistry and physics; the latter escapes chemistry and physics" (1975, p. 230). Max Delbrück, the father of molecular genetics and a Nobel laureate, found even more deeply puzzling the matter of how human rationality could have evolved out of "natural" occurrences. He wrote:

> Why, then, do the formal operations of the mind carry us so much further? Were those abilities not also matters of biological evolution? If they, too, evolved to let us get along in the cave, how can it be that they permit us to obtain deep insights into cosmology, elementary particles, molecular genetics, number theory? To this question I have no answer (1978, p. 353; cf. also Delbrück, 1986, p. 280).

E.O. Wilson noted in his book, *Consilience*: "But even as mind-body dualism is being completely abandoned at long last, in the 1990s, *scientists remain unsure about the precise basis of mind*" (1998, p. 99). Nobel laureate Roger Sperry commented in a similar vein:

> At the same time the evidence shows that *the great bulk of the evolving web of creation is governed by a complex pattern of great intricacy* with many mutually reinforcing directive, purposive constraints at higher levels, particularly. *The "grand orderly design" is, in a sense, all the more remarkable for having been self-developed*….
>
> The point is that human nature and these *higher kinds of controls in nature* don't reduce any more to physical and chemical mechanisms, but *have to be reckoned with now in their own form, in their own right. Vital, mental, social and other higher forces*, once evolved, become just as real as the evolved forces of molecules and atoms and *must be given their due, over and above the elementary physical components* (as quoted in Cousins, 1985, pp. 85–86, 87).

In an interview ("You Have to be Obsessive") in the February 17, 2003, issue of *Time* magazine, the cover-story article of which was intended to celebrate the fiftieth anniversary of James Watson and Francis Crick's discovery of the structure of DNA, Dr. Watson commented:

> We have more frontiers [in biology] now than when I was getting started. *How the mind works, for example, is still a mystery*. We understand the hardware, but we don't have a clue about the operating system. There are enough questions to keep people occupied for the next hundred years (2003, p. 52).

Writing on the subject, "What is Mind?," for the online journal, *Brain & Mind* (for which she serves as editor), Silvia Cardoso asked:

> But...what about the mind?… [A] few neuroscientists, such as the Nobel Prize recipient Sir John Eccles, asserted that the mind is distinct from the body. But most of them now believe that all aspects of mind, which are often equated with consciousness, are likely to be explained in a more materialistic way as the behavior of neuronal cells. In the opinion of the famous neurophysiologist José Maria Delgado [1969, p. 30]: "It is preferable to consider the mind as a functional entity devoid of metaphysical or religious implications *per se* and related only to the existence of a brain and to the reception of sensory inputs" (1997/1998).

Yet Cardoso admitted:

> Mind is a definition which tries to rescue the essence of man. *The essence of a person arises from the existence of mental functions* which permit him or her to think and to perceive, to love and to hate, to learn and to remember, to solve problems, to communicate through speech and writing, to create and to destroy civilizations (1997/1998).

Daniel Dennett, in *Kinds of Minds*, wrote: "It's easy enough to see why a mind seems miraculous, when one has no sense of all the components and how they got made" (1996, pp. 153–154). Trefil asked:

> The mind is…well, what is it, exactly? Formal definitions usually mention something like "the sum of mental activities," but that doesn't tell us very much. On the other hand, we all have had the experience of mind. Close your eyes and think of an episode from your childhood. You probably can conjure up a fairly detailed visual image of some setting, maybe even some sounds and smells. *You have these images "in mind," but where, exactly, are they*?… (1996, pp. 217–218, first ellipsis in orig.).

This question of "where" has troubled materialistic evolutionists for decades.

Can "mind" be reduced simply to "the firing of neurons"? In addressing this very issue, E.O. Wilson wrote:

> Most believe that the fundamental properties of the elements responsible for mind—neurons, neurotransmitters, and hormones—are reasonably well known. *What is lacking is a sufficient grasp of the emergent, holistic properties of the neuron circuits, and of cognition, the way the circuits process information to create perception and knowledge*…. Who or what within the brain monitors all this activity? No one. Nothing. The scenarios are not seen by some other part of the brain. They just ARE…. Consciousness is the massive coupled aggregates of such participating circuits (Wilson, 1998, pp. 109, 110).

The last part of Dr. Wilson's quote is another terrific example of a "just-so" story. But notice what he admits is "lacking" in regard to explaining mind and/or consciousness—a sufficient grasp of the emergent, holistic properties of the neuron circuits, and of cognition, the way the circuits process information to create perception and knowledge. Physicist Erwin Schrödinger correctly pointed out, in fact:

> *Not every nervous process, nay by no means every cerebral process, is accompanied by consciousness*. Many of them are not, even though physiologically and biologically they are very much like the "conscious" ones, both in frequently consisting of afferent impulses [conveying nerve impulses to the central nervous system] followed by efferent ones [conveying nerve impulses away from the central nervous system]… (1967, p. 101).

In an article on "Brain, Mind and Behavior," Malcolm Jeeves recognized what he called the "take-home message" in regard to the brain-mind problem.

> Nevertheless, the same take-home message emerged from all of these studies, whether human or animal, namely, the remarkable localization of function in the brain and the specificity of the neural substrate underlying mental events. *As each advance occurred, mind and brain were seen to be ever more tightly linked together* (1998, p. 81).

Evidence of the fact that the “mind and brain” are indeed “tightly linked together” came to the forefront between May 1973 and February 1974 when three teams of American astronauts participated in prolonged orbital flights known as the Skylab Program. During this exercise, astronauts spent 84 days in space—longer than ever previously attempted. The flights were designed to enable ground-based specialists to monitor the health of people in space. One of NASA’s principal discoveries was that on the day the astronauts were due to return to Earth (and thus, admittedly, a day that they would have been under a great deal of stress), the astronauts’ immune systems were visibly affected. Important processes in the immune system (such as white-cell transformation) were abnormally depressed. Remember: the astronauts’ environment had not changed. The “matter” that surrounded them had not changed. Yet their mental states had changed dramatically. This provided additional evidence which documented that the mind could have a physical effect on the body. But how can the mind do that if it is merely a brain made up of neuronal circuits?

Brain researcher Roger Sperry spent his entire adult career trying to get “a sufficient grasp” of the “brain/mind problem.” It was from that perspective that he admitted:

> I have not been inclined to look particularly at the little molecules of the brain or even at its big macro-molecules in this connection. *It has always seemed rather improbable that even a whole brain cell has what it takes to sense, to perceive, to feel or to think on its own*” (1977, p. 424).

Roger Lewin of Harvard spoke to this when he said:

> *The magic of it all is that while no single neuron is conscious, the human brain as a whole is*…. How does it do it? How are simple electrical signals across individual cell membranes transformed into cascades of cognition? How are billions of individual neurons assembled into a brain, seat of the mind? (1992, p. 163).

One of the overriding questions in regard to the so-called brain/mind problem, as Dr. Lewin noted, is how a single cell (i.e., a neuron) that *is not conscious* somehow *becomes conscious*. As Dennett put it:

> Each cell—a tiny agent that can perform a limited number of tasks—is about as mindless as a virus. Can it be that enough of these dumb homunculi—little men—are put together the result will be a real, conscious person, with a genuine mind? According to modern science, there is no other way of making a real person (1996, p. 23).

He is absolutely right. According to modern science, “mind” does not, and cannot, arise out of the “mindlessness” of “just” brain cells. Gordon Rattray Taylor, in *The Natural History of the Mind*, presented and discussed the medical evidence concerning consciousness, and concluded: “*Consciousness thus cannot be a property of neurones as such*” (1979, p. 75; “neurones” is the British spelling for neurons). Susan Greenfield, writing in 2002 on “Mind, Brain and Consciousness” for the *British Journal of Psychiatry*, concluded:

> *Within each macro brain region there is no single isolated complete function*…. So brain regions are bit players on the brain stage, and not autonomous units…. We can no more attribute autonomous functions to the most basic level of brain function—genes—than we can to the most macro—the brain regions. In both cases there is very little room for manoeuvre and *therefore it is hard to see how personalisation of the brain—the mind—might develop* (2002, p. 91).

As odd as it may sound, some researchers, in order to avoid the problem of how the mind could develop consciousness, have opted for exactly the opposite—that consciousness developed the mind! In his book, *Enchanted Looms: Conscious Networks in Brains and Computers*, Rodney Cotterill boldly suggested: “*I believe…that it is the mind that is the product of consciousness*. I believe, moreover, that it is the sheer abundance of experience mediated by consciousness that fools us into misunderstanding the nature of this fundamental attribute” (1998, p. 10).

While we were performing the research for this series

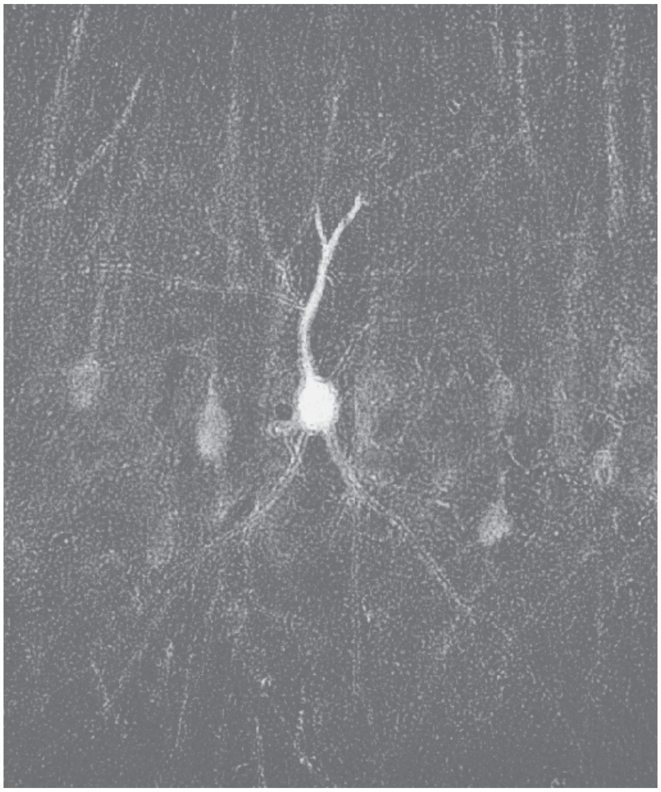

Figure 1. Is human consciousness held within single neurons?

of articles, we stumbled across one of the most concise, yet profound, discussions on these points that we have ever seen. Although it was penned eight decades ago, it appears as fresh and current as if it had been written yesterday. In his 1923 book, *Life: Its Origin and Nature*, Hereward Carrington made the following observations.

> *Certainly, the* MATTER *of the brain cannot in itself "think." There is no more reason why a certain specific nervous structure should give rise to active consciousness, than that any other complex living material should do so*. The question is: Does consciousness somehow ARISE from the flow of the nervous currents within the brain? Materialistic science says that the activities of the mind are somehow synonymous with these nervous currents….*The difficulty with this theory is that, for us, the important thing is the shadow and not the horse! And it is also difficult to explain why such a mere by-product should ever have come into being in the process of evolution. Furthermore the specific character of the relationship between these two (mind and brain) is not in the least explained by this formula. It merely states the facts. The primary question still remains: How can a particular thought (apparently a non-material thing) and a particular brain-change (a material thing) be related one to another?* (pp. 45, 49–50, parenthetical items in orig.).

Talk about "cutting to the chase" (and eighty years ago at that!). Carrington was right to ask: "How can a particular thought (apparently a non-material thing) and a particular brain-change (a material thing) be related one to another?" Should the fact that eighty years have passed, and neuroscience still cannot answer these types of questions, tell us something?

Is it possible that the problem lies with evolutionary theory? We are convinced that it does. If one begins with the wrong assumption, one inevitably will reach the wrong conclusion. The eminent biologist Paul Weiss elucidated this principle, from the standpoint of attempting to understand living organisms, when he wrote:

> Maybe our concept of our nervous system is equally inadequate and insufficient, because so long as you use only electrical instruments, you get only electrical answers; if you use chemical detectors, you get chemical answers; and if you determine numerical and geometrical values, you get numerical and geometrical answers. *So perhaps we have not yet found the particular kind of instrument that tells us the next unknown* (as quoted in Smythies, 1969, p. 252; Note: Weiss' comment is included in a discussion of a paper by J.R. Smythies, "Some Aspects of Consciousness," in *Beyond Reductionism*, edited by Arthur Koestler and J.R. Smythies).

After reading Dr. Weiss' assessment, Arthur C. Custance commented in his book, *The Mysterious Matter of Mind*: "Obviously, we shall not even try to INVENT this particular kind of instrument of research so long as we accept the monistic view of mind as really only the outworking of brain…" (1980, p. 23). "Modern science" begins with the wrong assumption (evolution), looks in the wrong place (the brain alone), and is using the wrong equipment (a materialistic viewpoint). As Eccles and Robinson put it:

> The theories of the brain-mind relationship that are today held by most philosophers and neuroscientists are purely materialistic in the sense that the brain is given complete mastery! The existence of mind or consciousness is not denied except by radical materialists, but it is relegated to the passive role of mental experiences accompanying some types of brain action, as in epiphenomenalism… (1984, p. 34).

Sperry was quite blunt in his forceful criticism of such materialism. "When reductionist doctrine tried to tell us that there are no vital forces, just as it also had long taught that there are no mental forces, *materialist science was simply wrong*" (as quoted in Cousins, 1985, p. 77). Or, as Eccles and Robinson went on to note:

> Finally, the most telling criticism of all materialist theories of the mind is against its key postulate that the happenings in the neural machinery of the brain provide A NECESSARY AND SUFFICIENT EXPLANATION OF THE TOTALITY BOTH OF THE PERFORMANCE AND OF THE CONSCIOUS EXPERIENCE OF A HUMAN BEING…. Our opposition to materialism, therefore, has been on exclusively metaphysical and scientific grounds and is not to be read as a veiled *apologia* for religion…. *The history of humanity establishes that there are human attributes—moral, intellectual, and aesthetic attributes—that cannot be explained solely in terms of material composition and organization of the brain* (1984, pp. 37, 169).

It is our contention that consciousness is one of the "human attributes" that "cannot be explained solely in terms of material composition and organization of the brain." But what about other animals?

Do Animals Possess Consciousness?

Stephen Jay Gould concluded that consciousness has been "vouchsafed only to our species in the history of life on earth" (1997, p. ix). Is Dr. Gould correct? Or do other creatures possess self-awareness as well? Certainly, the answer to such a question hinges on the definition one assigns to "consciousness." Ervin Laszlo, founder of the General Evolution Research Group, addressed this problem in *Evolution: The Grand Synthesis*, when he observed:

> The first thing to remember is that we cannot investigate

> the human mind with the methods used to investigate the human brain, or indeed any matter-energy system in the universe. Thoughts, images, feelings, and sensations are "private"; none of us has direct access to the mind of anyone else—not even of his closest friend or relative. Mind can only be investigated through introspection (1987, p. 117).

One way to approach the problem is to define consciousness with the broadest possible stroke and in the simplest possible terms. Steven Harnad, editor of *Behavioral and Brain Sciences*, did exactly that when he defined consciousness as "the capacity to have experiences" (as quoted in Lewin, 1992, pp. 153–154). Penrose followed suit in *The Emperor's New Mind*.

> Although frogs and lizards, and especially codfish, do not inspire me with a great deal of conviction that there is necessarily "someone there" peering back at me when I look at them, the impression of a "conscious presence" is indeed very strong with me when I look at a dog or a cat or, especially, when an ape or monkey in the zoo looks at me. I do not demand that they feel as I do, nor even that there is much sophistication about what they feel. *I do not ask that they are "self-aware" in any strong sense.... All I ask is that they sometimes* SIMPLY FEEL! (1989, p. 383).

If these are the sole criteria for defining consciousness—the capacity to "just have experiences" or to "sometimes simply feel"—then animals obviously possess consciousness, since they "have experiences." The problem is that such simple definitions of consciousness are woefully inadequate (we even would go so far as to say they are, if you will pardon the intended pun, "simply" wrong!). And, by and large, those in the scientific and philosophical communities have acknowledged as much. Robert Ornstein, in his book, *The Evolution of Consciousness*, suggested: "*Being conscious is being aware of being aware*. It is one step removed from the raw experience of seeing, smelling, acting, moving, and reaction" (1991, pp. 225–226).

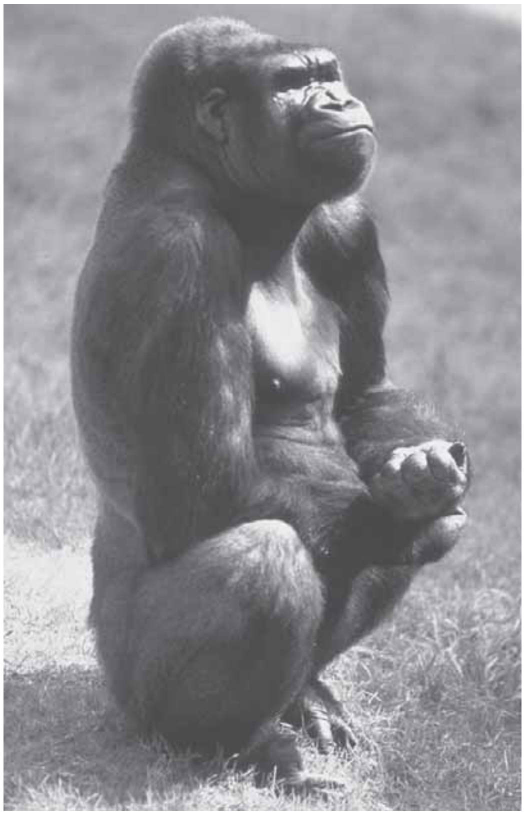

Figure 2. Do animals possess the same self-awareness as humans?

That "one step" is a mighty *big* step, however! The difference between merely "being aware" (i.e., "just having experiences" or "simply feeling") and actually being "*self* aware" (i.e., *knowing* that you are having experiences, and *knowing* that you are feeling) is colossal—a fact that seems to have eluded some who wish to imbue "other species" with the trait of consciousness. Marian Dawkins, author of the book, *Through Our Eyes Only? The Search for Animal Consciousness*, is a good example. She wrote:

> Our near-certainty about (human) shared experiences is based, amongst other things, on a mixture of the complexity of their behavior, their ability to "think" intelligently and on their being able to demonstrate to us that they have a point of view in which what happens to them MATTERS to them. We now know that these attributes—complexity, thinking and minding about the world—are also present in other species. *The conclusion that they, too, are consciously aware is therefore compelling.* The balance of evidence (using Occam's razor to cut us down to the simplest hypothesis) is that they are and it seems positively unscientific to deny it (1993, p. 177, parenthetical item in orig.).

But we are not talking about other species being "consciously aware." We are talking about them being "consciously *self*-aware." As Laszlo went on to say:

> The human mind, however, is not just the subjective side of a two-sided survival mechanism. The mind, as introspection reveals, is also the seat of abstract thought, feeling, imagination, and value. *I not only sense the world, I also interpret my sensations*. Like presumably all human beings, *I have consciousness. I am aware of having sensations and, on successively higher levels of abstraction, I am aware of being aware of having sensations*. Ultimately I, like other members of the human species, learn to abstract from immediate sensations *in ways that lesser species cannot*, and can come to deal with pure FORMS of thought. These include scientific and mathematical concepts, aesthetic constructions, and the abstract meanings of words and concepts. Consciousness is not a mysterious transcendental trait: it is the capacity for inter-

> nally describing the internal description of the perceived and conceived environment (1987, p. 118).

Peter Wilson, in *Man: The Promising Primate*, therefore concluded:

> It seems to me that human *self-consciousness is something that is "personal" to the human species*, if only in the simple sense that other animals cannot have a consciousness of being human. Anything that is personal to a species cannot have originated or have any meaning in any way other than through self-reference, that is, *the individuals making up the species must think about themselves and must have been in a problematic situation that made thinking about themselves productive and adaptive* (1980, p. 96).

Do other species "think about themselves" in "productive and adaptive" ways? Remember: we are not asking if animals possess instinct. Nor are we asking if they can "adapt." We are inquiring as to whether or not they are *self-aware*—to the extent that they actually "think about themselves." Eccles concluded: "It has been well said that an animal knows, but only a man knows that he knows" (1967, p. 10). Nick Carter, in an article titled "Are There Any Insurmountable Obstacles to Descartes' Dualism?," wrote that we might think of animals "as beings that have extension and sensation, but not thought" (2002). In the context, he was speaking of "higher thought"—the ability to think, to think about thinking, and to let others know we are thinking. Humans not only possess such self-awareness and thought capability, but also *the ability to let other humans know that they possess those two things*! As Harvard's Nobel laureate George Wald concluded:

> *I have all kinds of evidence that other persons are conscious; our mutual communication through speech and writing helps greatly*…. There is no way to shore up scientifically one's prejudices about animal consciousness. One is in the same trouble with nonliving devices. Does that garage door resent having to open when the headlights of my car shine on it? I think not. Does a computer that has just beaten a human player at chess feel elated? I think not. But there is nothing one can do about those situations either (1994, p. 128).

In their book, *Evolution*, Dobzhansky, et al., followed this same line of reasoning.

> In point of fact, *self-awareness is the most immediate and incontrovertible of all realities*. We infer the existence of self-awareness, or mind, in people other than ourselves only by analogy with our own introspective experiences…. No wonder that competent scientists are far from unanimous in their judgments. Some are willing to ascribe the beginnings of mind to some mammals (apes, monkeys, dogs), or even to all animals with developed nervous systems. Other scientists make mind an exclusively human possession. For example, Teilhard de Chardin, in a now-famous statement, wrote: "*Admittedly the animal knows. But it cannot know that it knows—this is quite certain*…." Human self-awareness obviously differs greatly from any rudiments of mind that may be present in nonhuman animals. *The magnitude of the difference makes it a difference in kind, and not one of degree. Without doubt, the human mind sets our species apart from nonhuman animals*. Unfortunately, what we call the mind is notoriously refractory to scientific study (1977, p. 453).

While the mind may be "notoriously refractory to scientific study," there are certain things we do know, in addition to those items mentioned above. As Ehrlich confessed (from an evolutionary viewpoint): "…[H]uman beings are also the only animals that seem fully aware of the consciousness of other individuals and thus have been able to develop empathy, the capacity to identify emotionally with others" (2000, p. 111). Nowhere is this more evident that in the human response to death. Dobzhansky concluded: "Self-awareness has, however, brought in its train somber companions—fear, anxiety and death awareness…. Man is burdened by death-awareness. A being who knows that he will die arose from ancestors who did not know" (1967, p. 68).

But consider (to choose just one example) the animal that evolutionists believe is our closest living relative—the chimpanzee. Famed paleoanthropologist Richard Leakey admitted:

> …[C]himpanzees at best seem puzzled about death…. The chimpanzees' limitation in empathizing with others extends to themselves as individuals: *no one has seen evidence that chimps are aware of their own mortality*, of impending death. But, again, how would we KNOW?… Ritual disposal of the dead speaks clearly of an awareness of death, and thus an awareness of self (1994, pp. 153, 155).

Dobzhansky, et al., also addressed this same point.

> *Ceremonial burial is evidence of self-awareness because it represents an awareness of death. There is no indication that individuals of any species other than man know that they will inevitably die*…. The adaptive function of death awareness is not as clear. What conceivable advantage could our remote ancestors at the dawn of humanity derive from knowing that they would inevitably die?… It is most probable that *death-awareness arose* originally not because it was adaptively useful by itself, but *because it was a by-product of self-awareness*, which was adaptive (1977, p. 454).

The information contained in the two quotations above

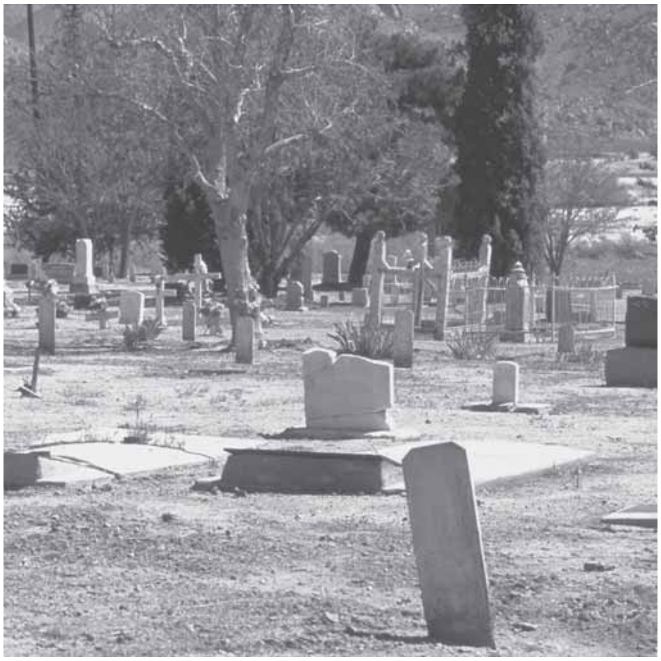

Figure 3. Only humans carry-out elaborate rituals for their dead—an indication that they, unlike animals, are self aware.

can be summarized as follows: (1) chimpanzees are unaware of their own mortality, and have no ability to empathize emotionally with others (a peculiarly human trait, according to Ehrlich); (2) in fact, there is no indication that individuals of *any* species other than humans know they will inevitably die; (3) death-awareness arose because it was a product of self-awareness; and (4) ceremonial burial is evidence of self-awareness because it represents an awareness of death.

Now, note the logical conclusion that inescapably follows. Death-awareness and ceremonial burial are allegedly evidence of, and products stemming from, self-awareness. But chimps (our nearest supposed relative), *like all animals*, do not comprehend the fact that they will one day die, and do not perform ritualistic burials of their dead. *If understanding death and burying the dead are evidence of self-awareness, and if no animal understands death or buries its dead, then no animal is self-aware!*

The scientist who literally "wrote the book" on animal consciousness, Donald R. Griffin, published the first edition of his now-famous work, *Animal Minds: Beyond Cognition to Consciousness*, in 1992, and the second edition in 2001. In that second edition, he offered the following assessment of animal consciousness.

> Can scientific investigation of animal mentality tell us whether animals are conscious? The short answer is "not yet," because it is very difficult to gather convincing evidence about whatever conscious experiences may occur in animals.... Have scientists proved conclusively that animals are never conscious, perhaps by means of evidence so complex and technical (like quantum mechanics) that ordinary people cannot understand it? No, almost all biologists and psychologists who study animal behavior avoid any such sweeping claim, and they often grant that some animals are probably conscious at times. But they hasten to argue that there is no way to tell whether they are or not, and that for this reason the subject cannot be investigated scientifically.... *Although the available evidence does not prove conclusively that any particular animal is conscious*, it is quite sufficient to open our eyes to an appreciative view of animals in which we attempt to understand what life is like for them....
>
> It is important to distinguish between perceptual and reflective consciousness. The former, called "primary consciousness," includes all sorts of awareness, whereas the latter is a subject of conscious experiences in which the content is conscious experience itself. Reflective consciousness is thinking, or experiencing feelings, about thoughts or feelings themselves, and *it is often held to include self-awareness and to be limited to our species*.... Many behavioral scientists...believe that it is likely that animals may sometimes experience perceptual consciousness but that reflective consciousness is a unique human attribute....
>
> *[R]eflective consciousness...is a form of introspection, thinking about one's thoughts, but with the addition of being able to think about the thoughts of others....*
>
> [T]here are in fact several kinds of evidence bearing on the question of animal consciousness.... One type of evidence is especially relevant, and yet it has been almost completely neglected by scientists. This is animal communication. To appreciate its relevance, *we need only ask ourselves how we judge whether our human companions are aware of anything or what the content of their conscious experiences may be. Our chief source of evidence comes from human communication.... The principal difference between human and animal consciousness is probably in their* CONTENT (pp. x, xi, 7, 8, 15).

"The question of animal consciousness," says Dr. Griffin, is an "open one." Admittedly, "reflective consciousness" (which includes, among other things, self-awareness, the process of introspection, and the ability to invent symbolic language—all essential, definitive traits of human consciousness) has eluded every member of the animal kingdom. But, Griffin opined, "the principal difference between human and animal consciousness is probably in their content" (p. 15).

That last statement must surely rank as one of the greatest understatements of all times. "Other than your husband's assassination, Mrs. Lincoln, how did you enjoy the play?" "Except for the difference in their content, what is the difference in human and animal consciousness?" Does anyone besides us see something terribly wrong here? As Tattersall put it:

> But comfortable as monkeys may become with mirrors and their properties, it has also been shown that they cannot identify their own reflection in a mirror…. What do we make of all this? First, it is evident that *there is a qualitative difference among the perceptions of self exhibited by monkeys, apes, and human beings* (2002, p. 65).

Key in on Tattersall's reference to monkeys and mirrors, and allow us to explain the significance of such a concept. For more than thirty years, researchers have tried to determine a way to test—objectively—whether any given animal is "self-aware." In *The Origin of Humankind*, paleoanthropologist Richard Leakey concluded: "An experience as private as consciousness is frustratingly beyond the usual tools of the experimental psychologist. This may be one reason that many researchers have shied away from the notion of mind and consciousness in nonhuman animals" (1994, pp. 149–150). Or, as Griffin noted: "Both reflective consciousness and self-awareness are often held to be uniquely human attributes." Then, in speaking of animals, he asked: "What sorts of evidence might indicate whether or not they think about their own thoughts?" (2001, p. 277).

Good question. What "sorts of evidence" could lead scientists and philosophers to conclude that at least some animals possess self-awareness? There have been a number of suggestions offered, such as mind-reading (i.e., the ability to comprehend what another animal has in mind to do in order to alter behavior), divided attention (the ability to concentrate on more than one thing at a time), delayed response (acting later, as if on the "memory" of something), self-recognition (the ability of an animal to recognize itself, as opposed to other animals of its kind), etc.

But it has been self-recognition, for the most part, that has captured the attention of various researchers. In the late 1960s, one of those researchers was Gordon G. Gallup, a psychologist at the State University of New York, Albany. Dr. Gallup devised a test intended to determine an animal's "sense of self"—the mirror test. His idea was that if an animal were able to recognize its own reflection in a mirror as "itself," then it could be duly said to possess an awareness of itself, i.e., consciousness. Gallup's report of the experiment was published in a 1970 article in *Science*. It has been called "a milestone in our understanding of animal minds" (Leakey, 1994, p. 150). Here is how the test was carried out.

An animal (such as a chimpanzee, an orangutan, or a gorilla) is left in a room to become familiarized with a mirror. After a period time, the animal is gently anesthetized. While it is asleep, a dot is painted on its forehead with paint. The animal then is allowed to wake. After the animal has fully recovered, the mirror is brought back. As Merlin Donald observed in A *Mind So Rare*:

> Most animals will take no notice of the dot and continue to treat the image in the mirror as if it were another animal. But certain ape subjects instantly recognize themselves in the mirror and touch their foreheads as if they knew that (a) the forehead in question was their own and (b) they didn't normally have a dot on it. Monkeys and other mammals do not behave this way. They do not see themselves in the mirror image (2001, p. 141).

In speaking of some of those "ape subjects" (chimpanzees and orangutans), Ian Tattersall remarked:

> Their immediate reaction was to use the mirror as an aid in picking the paint off their faces. Clearly they had recognized themselves, and they were soon pulling faces and exploring their persons using the unfamiliar opportunity. Interestingly, several gorillas tested did not seem to recognize themselves, although one, the famous Koko, a sign language star, definitely does recognize her own reflection (2002, pp. 63–64).

Mirror self-recognition has been extensively studied and discussed since the Gallup experiment, as reviewed in the book, *Self-awareness in Animals and Humans: Developmental Perspectives*, edited by Parker, Mitchell, and Boccia (1994). What, then, should we make of all this? Or perhaps a more appropriate question is: What have *researchers* made of all this? First, as Leakey admitted, "…psychologists wondered how widespread self-recognition would prove to be. Not very, is the answer. Orangutans passed the mirror test, but, surprisingly, gorillas did not" (p. 150). Harvard's Griffin admitted:

> It is difficult to be certain whether the failure of most animals to recognize mirror images as representations of their own bodies demonstrates that they are incapable of self-awareness, as Gallup claims, or whether they fail for some other reason to correlate the appearance and movements of the mirror image with those of their own bodies (2001, pp. 275–276).

Yet, while Griffin acknowledged that when the mirror-test results are in, it still is "difficult to be certain" about whether animals who pass the test are self-aware, he nevertheless went on to say: "On balance, it seems most likely that mirror self-recognition as indicated by the Gallup-type experiment does strongly indicate self-awareness" (p. 276). Donald commented: "A loose hierarchy emerges form these considerations. Bits and pieces of conscious capacity appear in different species. Even perception, short-term memory, flexibility of mind, and mindreading skill might be stronger in one species and weaker in another." However, humans, he concluded, "have more of everything. We might be called superconscious. But other species have many component features of our conscious capacity" (p. 130). But are those "component features" enough to justify animals being thought of as possessing consciousness?

Conceding the obvious—that some of the experimental subjects did appear to recognize themselves in the mirror—Tattersall inquired:

> [T]he fact that most apes recognize their own reflections in mirrors surely is significant at some level, especially when we realize that monkeys do not…. So far so good, perhaps; *but does the ability to recognize oneself in a mirror convincingly demonstrate that one has a* CONCEPT *of self?* This is a tough issue, but most cognitive scientists would, I think, argue that without such a concept individuals would lack any means of interpreting the reflected image, and would thus be unable to recognize themselves. *Nonetheless, even if we accept this, where does it leave us?* It seems equally likely that recognizing one's reflection is only a part—maybe even, just one small consequence—of what we human beings are familiar with as the concept of self (pp. 63–64).

Dr. Tattersall has raised several important points. First, does the ability to recognize oneself in a mirror "convincingly demonstrate that one has a *concept* of self? Second, if we answer yes to such a question "where does that leave us?" And third, is it possible that "recognizing one's reflection *is* 'only a part'—maybe even just one small consequences—of what we human beings are familiar with as the concept of self"?

In his appraisal of the concept of self-awareness, Robert Wesson observed:

> Self-awareness is a special quality of the mind. A computer may be able to analyze difficult problems, but we do not suppose that it is self-aware, that is, has a mind. *Self-awareness is different from information processing;* even when confused and unable to think clearly, one may be vividly aware of one's self and one's confusion. *The essence of mind is less data processing than will, intention, imagination, discovery, and feeling* (1997, p. 277).

Dr. Wesson is correct. Self-awareness *is* different from mere information processing. The chimpanzee or orangutan with a spot of paint on its forehead may be able to process the information that tells the animal it has a spot of paint on its forehead. But does that mean the chimpanzee or orangutan possesses intention, imagination, discovery, feeling, and all the other things that we normally associate with consciousness and/or self-awareness? Hardly. Listen to Daniel Dennett's assessment.

> We human beings do many intelligent things unthinkingly. We brush our teeth, tie our shoes, drive our cars, and even answers questions without thinking. *But most of these activities of ours are different, for we* CAN *think about them in ways that other creatures can't think about their unthinking but intelligent activities….What makes a mind powerful—indeed, what makes a mind conscious—is not what it is made of it, or how big it is, but what it can do.* Can it concentrate? Can it be distracted? Can it recall earlier events? Can it keep track of several different things at once? Which features of its own current activities can it notice or monitor?…
>
> [T]he dog cannot consider its concept. It cannot ask itself whether it knows what cats are; it cannot wonder whether cats are animals; it cannot attempt to distinguish the essence of cat (by its lights) from the mere accidents. Concepts are not things in the dog's world in the way that cats are. Concepts ARE things in our world… (1996, pp. 154–155, 158, 159).

What sets human consciousness apart from animals, with their "bits and pieces" or "component features of conscious capacity" is, as Dennett correctly observed, *what the human mind can do*! Anthony O'Hear assessed the situation quite succinctly when he commented that a "self-conscious person"

> does not simply have beliefs or dispositions, does not simply engage in practices of various sorts, does not just respond to or suffer the world. He or she is aware that he or she has beliefs, practices, dispositions, and the rest. It is this awareness of myself as a subject of experience, as a holder of beliefs, and an engager in practices which constitutes my self-consciousness. *A conscious animal might be a knower…but only a self-conscious being knows that he is a knower* (1997, p. 24).

When Griffin asked "Can scientific investigation of animal mentality tell us whether animals are conscious?," and answered, "not yet" (2001, p. x), he fairly well summed up most researchers' opinion of the matter. While he personally believes that "the weight of the evidence" suggests that many animal species do possess "perceptual consciousness," he nevertheless was willing to admit: "But it remains an open question" (p. 277). And it is safe to say that "the researchers" are badly split on whether or not even "advanced mammals" (like, for example, chimpanzees and orangutans) can justifiably be said to possess self-awareness. For example, three contributors to a 1997 symposium volume (*Animal Consciousness and Animal Ethics*) argued that many animals do have conscious experiences of some sort. But just as many (or more) other contributors disagreed (see Dol, et al., 1997).

In the book he wrote that contained lengthy interviews with a variety of scientists and philosophers on consciousness (*Complexity: Life at the Edge of Chaos*), Roger Lewin asked Tufts University philosopher Daniel Dennett (the author of *Consciousness Explained*): "So you are denying this kind of consciousness to all animals but humans?" Dr. Dennett responded: "I am." Lewin then remarked: "No animal without language experiences a sense of self, argued Dan, not in the way that humans experience self" (Lewin, 1992, p. 157). We concur, and agree with Gerald Edelman, who wrote: "While we may not be the only conscious animals, we are, with the possible exception of the chimpanzee, the only self-conscious animals" (1992, p. 115).

But *why* is all of this so? W.H. Thorpe was constrained to say: "I find it very difficult to imagine a highly organized consciousness which could be of real use to the animal in its everyday *life without a fairly elaborate mechanism behind it*" (Thorpe, 1965, p. 498).

Humans Created Unique

In evaluating the differences between animals and humans one must understand that from as far back as the Creation week humans were created different from the animals. Biblical teaching regarding man acknowledges that he is composed of two distinct parts—the physical and the spiritual. We get an introduction to the origin of the *physical* portion as early as Genesis 2:7 when the text states: "Jehovah God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul (*nephesh chayyah*)." It is important to recognize both what this passage is discussing and what it is not. Genesis 2:7 *is* teaching that man was given *physical life*; it is *not* teaching that man was instilled with an *immortal nature*. The immediate (as well as the remote) context is important to a clear understanding of the intent of Moses' statement. Both the King James and American Standard Versions translate *nephesh chayyah* as "living soul." The Revised Standard Version, New American Standard Version, New International Version, and the New Jerusalem Bible all translate the phrase as "living being." The New English Bible translates it as "living creature."

The variety of terms employed in our English translations has caused some confusion as to the exact meaning of the phrase "living soul" or "living being." Some have suggested, for example, that Genesis 2:7 is speaking specifically of man's receiving his immortal soul and/or spirit. This is not the case, however, as a closer examination of the immediate and remote contexts clearly indicates. For example, the apostle Paul quoted Genesis 2:7 in 1 Corinthians 15:44–45 when he wrote: "If there is a natural body, there is also a *spiritual body*. So also it is written, 'The first man Adam became a living soul.' The last Adam became a life-giving spirit." The comparison/contrast offered by the apostle between the first Adam's "natural body" and the last Adam (Christ) as a "life-giving spirit" is absolutely critical to an understanding of Paul's central message (and the theme of the great "resurrection chapter" of the Bible, 1 Corinthians 15), and must not be overlooked in any examination of Moses' statement in Genesis 2:7.

There are six additional places in the Old Testament where similar phraseology is employed, and in each case the text obviously is speaking of members of the animal kingdom. In Genesis 1:24, God said: "Let the earth bring forth living creatures (*nephesh chayyah*) after their kind." Genesis 1:30 records that God provided plants as food "to every beast of the earth, and to every bird of the air, and to everything that creeps on the earth, everything that has the breath of life (*nishmath chayyah*)." When the Genesis Flood covered the Earth, God made a rainbow covenant with Noah and with every living creature (*nephesh chayyah*) that was in the ark with Him (Genesis 9:12). God pledged that He would remember the covenant that He made with every "living creature" (*nephesh chayyah*; Genesis 9:12), and therefore He never again would destroy the Earth by such a Flood. The rainbow, He stated, would serve as a reminder of that "everlasting covenant" between God and every living creature (*nephesh chayyah*, Genesis 9:15). The final occurrence of the phrase is found in Ezekiel's description of the river flowing from the temple in which every living creature (*nephesh chayyah*) that swarms will live (47:9).

Conclusion

The Bible declares: "For that which befalleth the sons of men befalleth beasts; even one thing befalleth them: as the one dieth, so dieth the other; yea, they have all one breath; and man hath no preeminence above the beasts" (Ecclesiastes 3:19). Does this mean, therefore, that man possesses only a material nature and has no immortal spirit? No, it does not! In speaking to this very point, Jack P. Lewis wrote:

> It would seem that arguments which try to present the distinctiveness of man from the term "living soul" are actually based on the phenomena of variety in translation of the KJV and have no validity in fact. Had the translators rendered all seven occurrences by the same term,

> we would have been aware of the fact that both men and animals are described by it. To make this observation is not at all to affirm that the Old Testament is materialistic. We are concerned at this time only with the biblical usage of one term. Neither is it to deny a distinction in biblical thought between men and other animals when one takes in consideration the whole Old Testament view. Man may perish like the animals, but he is different from them. Even here in Genesis in the creation account, God is not said to breathe into the animals the breath of life; animals are made male and female; there is no separate account of the making of the female animal; they are not said to be in God's image and likeness; they are not given dominion. Man is the crown of God's creation (1988, p. 7).

When Dr. Lewis suggested that "man may perish like the animals," he captured the essence of the passage in Ecclesiastes 3:19. It is true that both men and beasts ultimately die, and that in this regard man "hath no preeminence above the beasts." Yet while both creatures are referred to as *nephesh chayyah*, the Scriptures make it clear that God did something special in reference to man. Genesis 1:26–27 records: "And God said, Let us make man *in our image, after our likeness*.... And God created man in his own image, in the image of God created he him; male and female created he them." Nowhere does the Bible state or imply that animals are created in the image of God. What is it, then, that makes man different from the animals?

The answer, of course, lies in the fact that man possesses an immortal nature. Animals do not. God Himself is a spirit (John 4:24). And a spirit "hath not flesh and bones" (Luke 24:39). In some fashion, God has placed within man a portion of His own essence—in the sense that man possesses a spirit that never will die. The prophet Zechariah spoke of Jehovah, Who "stretcheth forth the heavens, and layeth the foundation of the earth, and formeth the spirit (*ruach*) of man within him" (12:1). The Hebrew word for "formeth," *yatsar*, is defined as to form, fashion, or shape (as in a potter working with clay; Harris, et al., 1980, p. 396). The same word is used in Genesis 2:7, thereby indicating that both man's physical body and his spiritual nature were formed, shaped, molded, or fashioned by God. The authors of the *Theological Wordbook of the Old Testament* noted:

> The participial form meaning "potter" is applied to God in Isa. 64:7 where mankind is the work of his hand. When applied to the objects of God's creative work, the emphasis of the word is on the forming or structuring of these phenomena. The word speaks to the *mode of creation* of these phenomena only insofar as the act of shaping or forming an object may also imply the *initiation of that object* (Harris, et al., 1980, p. 396).

As the Creator, God "initiates" the object we know as man's immortal nature (i.e., his spirit). Solomon, writing in the book of Ecclesiastes, noted that "the dust returneth to the earth as it was, and the spirit returneth unto *God who gave it*" (12:7). Man's physical body was formed of the physical dust of the Earth. Would it not follow, then, that his spiritual portion would be formed from that which is spiritual? When the writer of Hebrews referred to God as "the Father of our spirits" (12:9), he revealed the spiritual source of the our spirits—God.

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[Authors' Note: This article is an abbreviated discussion of this topic. A more complete treatment may be found in: Harrub, Brad and Bert Thompson. 2003. *The truth about human origins*. Apologetics Press, Montgomery, AL.]

The Unbridgeable Chasm Between Microevolution and Macroevolution

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Abstract

The concepts of microevolution and macroevolution are examined, focusing both on their similarities and differences. It is concluded that at least 17 criteria exist that demonstrate macroevolution is not merely an extension of microevolution as is often claimed by Darwinists. But, instead, they are two different processes that involve distinctively different mechanisms. A major difference is that microevolution has been demonstrated empirically, whereas macroevolution is largely the product of speculation. Another key difference is that microevolution involves *loss* of information, and macroevolution involves a *gain* of new information. A common approach to proving macroevolution is to demonstrate microevolution, and then infer by extension that macroevolution also has been proven. While this "bait and switch" tactic may be useful to win arguments, it does not justify the conclusion.

Introduction

Two basic and fundamentally different types of evolutionary change exist—one that usually is labeled *microevolution* (minor changes) and the other *macroevolution* (major changes), often called trans-species evolution. "Micro" is a Greek term that means small, and "macro" large or big, suggesting at first glance that only *quantitative* differences exist between these two processes. Actually, fundamental *qualitative* differences also exist between micro- and macroevolution. The key factor is necessarily not the *amount* of morphological change, but the *type* of change. This is indicated by the many other terms commonly used to describe both microevolution and macroevolution. For example, microevolution also is referred to as "adaptive variation" or "variations within the genesis kinds," while macroevolution is often called "Darwinism," "evolutionary naturalism," or "evolutionism."

The simplest and most common definition of the two terms is that microevolution involves "relatively small changes below the species level," while macroevolution involves "relatively large changes sufficient to produce new species and higher taxa" including new families, phyla, or genera (Price, 1996, p. 11). One of the most authoritative Darwinists, Ernst Mayr of Harvard, defined microevolution as "evolution at or below the species level" and generally "refers to relatively minor variations that occur in populations over time." Conversely, he defined macroevolution as "evolution above the species level; the evolution of higher taxa and the production of evolutionary novelties such as new structures" (Mayr, 1991, p. 182). In other words, macroevolution is a result of *cladogenesis*. A *clade* is a group whose members share a common ancestor, and cladogenesis is when a species line splits into two new species (Horvitz, 2002).

The Interbreeding Definition

Differentiations based on the species distinction are very common and very useful (but also very imperfect, because the species classification is often not clear). The definition of an animal species usually involves the ability to interbreed. If two animals can interbreed, they are considered part of the same species; if not, they are considered a different species. However, differentiation of species based upon interbreeding applies only to sexually reproducing organisms. Since many known species are asexual (and that number may increase dramatically in the next few decades; some microbiologists estimate we have only classified 1–5% of all bacteria species), many of all known species cannot be classified in this manner. In fact, even for sexual reproducing animals there are numerous exceptions, making it only a partially functional definition (Hey, 2001; Shaw, 2002).

Many other difficulties exist in using the ability of two groups to interbreed as the major distinction between macro- and microevolution. For example, some animals, e.g. large dogs such as the Great Dane and a small dog

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such as a terrier, normally cannot interbreed because of their size differences. Although these two dogs may not be able to interbreed naturally, both are part of the same species and can be made to interbreed by various methods, such as by artificial insemination or by breeding with a middle-sized animal first. In addition, some animals that can be made to interbreed have offspring that usually are sterile. The most common example is a female horse and a male donkey, which can breed to produce a mule that is usually sterile.

Speciation based upon interbreeding is complicated by those situations where Species A can interbreed with Species B, and Species B with Species C, but Species A and C cannot interbreed. Where is the true species division? This example shows how difficult it is to determine species divisions sharply and thus how subjective the field can become. Other animals regarded as different species such as lions and tigers, cows and buffaloes, camels and llamas, and wolves and dogs all have been interbred successfully. The Bryan College web site, as of this writing, lists 2,711 hybrid crosses (www.bryancore.org/hdb/). Furthermore, some so called microevolutionary changes are fairly large in the physical changes that can result (as is obvious with dog breeds).

For these reasons, other criteria in addition to the ability to interbreed must be used to differentiate species. It is also for this reason that many creationists prefer the term "baramin" or "genesis kinds" instead of "species" in discussions about micro- and macroevolution. Nonetheless, because the word species is widely used and is very useful, until a better term is widely used, we are forced to use an imperfect term that is appropriate if the reader understands its limitations. Furthermore, large biological changes can occur due to homeodomain mutations, for example, which do not involve increased genetic information and are representative of microevolution only. The reason is homeodomain genes regulate a large number of other genes, such as those needed to produce body limbs. A homeodomain mutation can cause, for example, a fly to develop an extra set of wings or no wings.

Thus, the claim that macroevolution occurs as a result of "new" species being created by microevolution is very problematic for many other reasons. As noted above, the species label is may be useful in classifying life, but sharp lines often cannot be drawn (Hey, 2001; Shaw, 2002). The definition and criteria used to define a species, genus, etc. generally are skewed by most taxonomists to favor evolutionary interpretations of the data. Taxonomists also often create a new species according to their understanding of how evolution works (i.e.. how they perceive microevolution to support macroevolution). Darwinists widely acknowledge the difficulties and ambiguity of species classification: taxonomic classification may result in ten species of finches even if evidence exists that these ten are not all legitimate separate species because the specialization that occurs is solely a result of genetic information loss, genetic shuffling, and/or new genetic combinations.

Is Macroevolution Just More Microevolution?

Some Darwinists attempt to argue that "evolution is evolution" no matter what you call it, and that there is no fundamental qualitative distinction between microevolution and macroevolution. They conclude that the difference is only a matter of degree on a continuum that is bridged by time. Many evolutionists attempt to argue that microevolution plus time, chance, and natural selection equals macroevolution. Under the subheading "Microevolution Versus Macroevolution," Mader (1998) argues that changes of the gene frequency in local populations are microevolution and that "evolutionists believe that the same processes have been involved in major transformations over geological time, such as those observed in *lineages*, lines of descent from a common ancestor (called *macroevolution*)." (p. 342)

Certain Darwinists even try to argue that the "intelligent design" theory lacks a scientific case and, therefore, are forced to confuse the issue by creating definitions and distinctions (such as micro-/macroevolution) that do not really exist. However, the microevolution/macroevolution distinction is widely used in the literature and textbooks by both scientists and writers (both creationists and anti-creationists) from Darwin to today. Examples include Horvitz (2002) and also Hickman et al. (1997), who defines microevolution as "genetic variation and change within a species" (p. 59) and macroevolution as "major evolutionary events" such as speciation (p. 41). Many textbooks include a whole chapter on microevolution and another chapter on macroevolution (for example see chapters 17 and 18 in Krogh, 2002).

Part of the problem in resolving this issue is that evolutionists themselves do not always agree on the exact meaning and appropriate usage of terms including "micro-" and "macroevolution," nor do they agree on the definition of a species. This paper addresses this matter, and concludes that major qualitative differences exist between microevolution and macroevolution. Macroevolution is not just microevolution plus time and chance; rather, as described below, the two biological processes are fundamentally different in critical ways (see Table I). Rensch (1959) and Woodward (2003) have documented a large number of leading authorities that have concluded macroevolution cannot be explained in terms of microevolution.

Criteria	Microevolution	Macroevolution
1. Other terms used	Variations within kinds, intra-evolution	Darwinism, evolutionism, trans-specific evolution
2. Kirkut's term	Special theory	General theory
3. Level of change	Below species level	Above species level
4. Examples	206 breeds of dogs, antibiotic resistance	Molecules to humans (common descent of all life)
5. Variation level	Generally within species	Beyond species or genera
6. Type of evolution	Horizontal	Vertical
7. Major sources	Shuffling existing genes (sexual reproduction, crossing over, and natural selection)	Creation of new genes (mutations and natural selection)
8. Increase in information?	No (rearrangement and loss only)	Yes (major increases required)
9. Change level	Usually minor changes (color frequency changes)	Generally major changes (evolution of wings)
10. Change measurable?	Yes, directly	No, not directly
11. Time	Seen in one or a few generations	Thousands of generations or more
12. History	Historical	Prehistorical
13. Evidence	Testable, experimentally verified	No direct evidence (inferred only)
14. Scientific acceptance	Universal	Controversial
15. Short/long age creationists' acceptance	Universal	Reject
16. Intelligent Design theorists' acceptance	Universal	Most reject
17. Atheists'/agnostics' acceptance	Universal	Nearly universal

Table I. Microevolution Versus Macroevolution

The Primary Difference is New Information

The terms macroevolution/microevolution (which focus on small-versus-large changes that are subjective) are also problematic because the central issue is *increased genetic information* (the production of new codes that make new functional protein parts, increase enzyme specificity, generate regulatory systems, form new transport proteins, etc.). The major difference that can most accurately be used to separate micro- and macroevolution is that microevolution involves a rearranging, sorting, and ultimately a *loss* of existing genetic information, whereas macroevolution requires the creation of *increased*, new original genetic information. Microevolution involves loss because natural selection removes information. In the words of Harvard professor Ernest Mayr (2001), "What Darwin called natural selection is actually a process of elimination ... [of] individuals of lower fitness" (pp. 117, 288).

The level of morphological changes, therefore, cannot be the chief criteria used to differentiate microevolution from macroevolution, but rather the criterion is the increase of genetic information. It is for this reason that the information-gain or information-loss criterion is the *primary distinction* between microevolution and macroevolution. Loss of genetic information alters the gene pool in the opposite direction of macroevolution. Hence, genetic mechanisms that give rise to the observable changes involved in microevolution actually work against macroevolution. The extant empirical, genetic evidence demonstrates that the genetic mechanisms that account for microevolution *cannot* produce the changes predicted by macroevolution (Anderson, 2001).

Macroevolution in Contrast to Microevolution

The level of structural change involved in microevolution is usually minor, often comparatively trivial, while in contrast, the change level required for macroevolution is major. The major difference is that microevolutionary changes have been demonstrated by numerous empirical studies (such as those on finches, dogs, and moths), but no direct evidence exists for macroevolution. Rather, macroevolution can only be inferred from evolutionary interpretations of the fossil record and other presumptive reasoning—a very problematic approach to prove a theory that has produced so much controversy.

Examples of microevolution include humans producing 206 breeds of dogs, and the development of antibiotic resistance by bacteria (Palumbi, 2001). As Price (1996) notes, "many experiments have demonstrated microevolution" (p. 11) and there is abundant proof that it has occurred, and still occurs today. Conversely, no experiment has yet been able to unambiguously demonstrate macroevolution. As Silvius (1994) notes:

> In addition to the contradictory fossil record, laboratory evidence offers little indication that mutations are the source of the awesome variation in millions of species. Thus, *there appears no mechanism for such extensive variation, and no prehistoric record that extensive variation occurred over time*. That is, there does not appear to be clear evidence for *macroevolution* (*general theory of evolution*), which allegedly occurs with no limits to biological change. Both Neo-Darwinism and punctuated equilibrium claim that there are no limits to genetic variation (p. 339).

Another critical difference is that microevolution can often be seen in one generation, while macroevolution is believed to require hundreds of generations or longer to be observable. Consequently, changes via microevolution have been demonstrated empirically, and evolutionists often offer these studies as the irrefutable evidence for Darwinism. Actually, the scientific acceptance of microevolution is universal, but macroevolution is still very controversial. Mayr (1982) concludes that

> The futile attempts to establish the relationship of the major phyla of animals induced at least one competent zoologist at the turn of the century to deny common descent. Fleischmann (1901) called the theory a beautiful myth not substantiated by any factual foundation. Kerkut, fifty years later ... is almost equally pessimistic about ever achieving an understanding of the relationship of the higher animal taxa. Honesty compels us to admit that our ignorance concerning these relationships is still great, not to say overwhelming. This is a depressing state of affairs considering that more than one hundred years have passed since the great *post-Origin* period of phylogeny construction (p. 218).

The acceptance of microevolution by both short- and long-age creationists is also universal, while most intelligent design theorists reject macroevolution. At a genetic level, microevolution primarily involves changes of allelic frequencies within populations (Hickman, et al., 2001). This change usually involves such mechanisms as sexual reproduction, gene cross-over, gene exchange (such as is common among bacteria), transposition and, to a small extent, some minor mutations.

In contrast, macroevolution requires *increased* information that produces new functional proteins and biological structures. Ultimately, the only viable mechanism that has been proposed for macroevolution is mutations, a mechanism that has been shown to be inadequate (Spetner, 1997).

Furthermore, “most of the evidence of large-scale evolutionary change (which is conveniently called macroevolution) comes from the fossil record” (Ridley, 1985, p. 134). And the fossil record always has been one of the major problems for macroevolution. Even anti-creationists recognize that “transitional fossils were real organisms that were adapted to the environment of their time” and they

> only become “transitional” in hindsight. Paleontologists of the future will consider organisms living today as “transitional.” Also remember that you can never know for certain that an individual fossil was ancestral to another fossil or to a currently living organism. All you can say for sure is that younger fossils (and modern organisms) had ancestors that lived at the same time as the individual fossil in question. An interesting question is: if evolution did not occur (or if it is limited to microevolution within “types”), why are there *any* transitional fossils at all? (Frymire, 2000, p. 17).

In response to Frymire, some researchers are convinced that *no* confirmed macroevolution transitional forms exist. The few putative transitional forms that are claimed are all highly debated, even among Darwinists. Given that over 1,000,000 animal species are now known to exist, and many more may have existed in the past (although Darwinists surmise that hundreds of millions of animal species have existed in the past, most all which are extinct, *evidence* exists for only about 150,000 extinct animals), many animals once existed that can be construed as “transitional,” especially when all we have to study is their fossilized bone fragments (Carroll, 1997). As Frymire (2000) notes, all we can know for sure from fossils is that the animal is probably extinct. We try to estimate when the animal lived, and then if it has traits that appear to be intermediate between an assumed more primitive animal (no easy task, considering that we usually have only bone fragments to judge from), we assume it is “transitional.”

The major source of the genetic variety for microevolution is the shuffling of existing gene pools, such as by sexual reproduction and genetic crossing over. This variety is exploited by artificial selection and, in the wild, by natural selection. In contrast, macroevolution includes evolution of molecules into single-cell life forms, and ultimately these single-cells into humans. Thus, macroevolution ultimately involves the formation of *increased* genetic information by mutations (discussed below), along with Darwinian natural selection of that new information which confers a survival advantage. New genes are thought to be created by mutations that cause a modification of existing genes, copying errors, and damage to the genome.

In addition, microevolution involves horizontal changes (variations that do not produce increased complexity, such as is required for atoms-to-human evolution, but rather changes such as color or size variations). In contrast, macroevolution involves vertical change (variations that produce increased levels of complexity, such as the evolution of new body organs). Table II summarizes some of the differences between microevolution and macroevolution according to Carroll (1997).

The Literature on the Micro/Macroevolution Dichotomy

In his seminal work on evolution, Kerkut (1965) categorized Darwinian ideas into two general theories, the “Special Theory of Evolution” and the “General Theory of Evolution.” Kerkut defined the “Special Theory of Evolution” as biological morphology changes resulting from genetic

Microevolution	**Macroevolution**
Based on observations of modern populations and species.	Based on evolutionary interpretations of the fossil record.
Most populations within species diverge progressively over time.	Major lineages appear suddenly in the fossil record and then persist for long periods of time
Evolutionary rates are relatively similar from lineage to lineage, and over time within a single lineage.	Evolutionary change appears to be very rapid during the origin of major groups and much slower within groups.
The entire range of possible morphologies is represented by some populations within the history of a species.	Significant gaps separate structural and adaptive patterns that are characteristic of major groups.

(Adapted from Carroll, 1997, p. 8.)

Table II. Carroll’s Comparisons of Micro- and Macroevolution

alterations, such as size and shape changes in finch beaks. These changes are testable because they typically can be observed in the laboratory or in nature.

Kerkut used the term "General Theory" to describe most aspects of macroevolution, which he defined as the theory that all living forms have evolved from a single source (i.e., the common descent of all life). Kerkut regards the "Special Theory" as proven but the "General Theory" as only "a working hypothesis" because the "evidence that supports it is not sufficiently strong to allow us to consider it as anything more ..." than this (p. 157).

Anderson (2001) argues that Kerkut's terminology achieves a precision that is lacking in the terms "micro" and "macro." Many Darwinists (such as Ernst Mayr) regard Kerkut's terminology as an excellent summary of Darwin's ideas (Anderson, 2001). Mayr even argues that the use of these terms is the best way to understand Darwin's writings. Darwin's *Origin of Species* consists largely of a detailed analysis of observable biological changes in nature (microevolution), along with his explanation of how he believed these changes could lead to even greater changes (but not directly observed), such as fish developing lungs, legs, and evolving into higher animals, eventually becoming humans. According to Mayr (1991), Darwin observed a number of biological changes or adaptations, and then tried to comprehend how these changes helped us to understand all biological diversity.

Michael Denton also used the "special theory" and "general theory" dichotomy. In a study of Denton's work, Woodward (2003) found that Denton first

> establishes a *split between Darwin's two theories*. On the one hand is the "special theory" of speciation, called "microevolution," which is the generation of slightly different sister species. On the other hand is the "general theory" of the evolution of all life forms from common ancestors, called "macroevolution." After splitting "micro" from "macro," Denton shows how Darwin himself distinguished the two in the *Origin* (p. 49).

Mayr concluded that Darwin made field observations of changes that were accounted for by "The Special Theory," and then extrapolated those conclusions to his "General Theory." In essence, Darwin concluded that if enough small changes could accumulate for a long enough period of time, they eventually would provide the level of biological change required to produce humans from inorganic molecules. Thus, the presumed relationship of the "General" and "Special Theory" is essentially the same as that of micro- and macroevolution. However, the terms "General Theory" and "Special Theory" are not in wide use today (although some feel that they should be), and therefore are not used here.

Can the Processes Associated with Microevolution Account for Macroevolution?

Darwin (and most subsequent Darwinists) assumed (assume) that the changes predicted by the "Special Theory of Evolution" are sufficient to produce new genetic information (and consequently a new species). Any factor that can produce a new species is assumed to ultimately give rise to a new genus, and eventually to a new family, a new order, etc. Some evolutionists even object to the terms "microevolution" and "macroevolution," suggesting that these terms serve only as a means that Darwin's critics use to confuse the issue. Some Darwinists also acknowledge that many people who reject macroevolution accept evolution as "adaptation within a species" but "argue that such small changes cannot explain the evolution of new groups of plants and animals" (Coyne, 2001, p. 588). Coyne argues that proof of microevolution proves macroevolution using the following reasoning:

> When, after a Christmas visit, we watch grandma leave on the train to Miami, we assume that the rest of her journey will be an extrapolation of that first quarter-mile. A creationist unwilling to extrapolate from micro- to macroevolution is as irrational as an observer who assumes that, after grandma's train disappears around the bend, it is seized by divine forces and instantly transported to Florida (Coyne, 2001, p. 588).

Among the various problems with this reasoning are: 1) We know that both grandma and the train remained unchanged during the entire trip, therefore her course is easy to follow and no speculation is necessary about where her journey took her, or how and when she was able to arrive safely. All of this can be empirically monitored. 2) Since train travel is routinely observed, it fits within observed facts (i.e., "The Special Theory"). But, by evolutionists' own acknowledgment, "macroevolution" is not readily observed in real time. Hence, it does not fit within commonly observed experience. Therefore, Coyne had proposed a false analogy. 3) Since macroevolutionary transformation of a train passenger has never been observed, we would not expect grandma to arrive at her destination in a Greyhound bus, or for her to be transformed into an Airedale or parakeet during the journey. Hence, we do not need to observe her for the entire journey to know in what form of transportation she will arrive or what she would look like when she arrives.

The Attempt to Prove Macroevolution Via Evidence for Microevolution

Darwinists have long argued that since microevolution is true, common descent must also be true. But years of research have consistently contradicted this assumption: variation produced by breeding is typically rapid initially, but then levels off until it reaches a ceiling that breeders cannot cross (Lester and Bohlin, 1984). For example, plant breeders have been working to increase the sugar content of the sugar beet since about 1800. In the first 75 years they improved it from 6 to 17 percent. However, they have been unable to increase the content very much since that time. Breeding horses for speed indicates that definite practical limits are achievable from breeding, and to go beyond these limits requires other means (such as genetic reengineering of major structures). Certain horse families tend to give rise to faster horses, but chance is critical. As one breeder expressed this problem, Secretariat's foals were mostly not Secretariats (Budiansky, 1997; Crowell, 1973).

Unfortunately, breeding usually produces extremes of one trait (seedless fruit, faster horses, bigger flowers, meatier cows) at the expense of other traits. Thoroughbreds are typically less healthy, a fact well known among dog owners. Also, breeding often develops one trait, but not the supportive traits. The fastest horses possess the muscles needed to run fast, but lack the total compliment accessory structures and, as a result, if pushed to their limits, commonly have joint, bone, and other major health problems. They can run faster than their body can cope, and all mechanical parts have certain limits. Breeding only shuffles existing information, it does not create new information. Physical characteristics are obtained by removing specific pools of genetic information, which allows a greater concentration of the information that contributes to the desired characteristic. Miniature horses are obtained by a breeding program that reduces the genetic information necessary for taller horses. Unfortunately, removal of certain genetic tracts also allows negative traits to accumulate (often because breeders inbreed heavily to maximize a desired trait). Darwin either was not fully aware of this critical problem or largely ignored it.

Actually Darwin based the vast majority of his arguments on extrapolating microevolution to macroevolution. The lethal problem with this logic comes from the fact that increased:

> knowledge of the fossil record over the past hundred years emphasizes how wrong Darwin was in extrapolating the pattern of long-term evolution from that observed within populations and species. If the patterns of evolution over time scales of millions and hundreds of millions of years are so different from those that Darwin postulated for modern populations and species, can the process of natural selection that he established on the basis of living species adequately explain long-term evolutionary phenomena? .... Biologists have long struggled with the conceptual gap between the small-scale modifications that can be seen over the short time scale of human study and major changes in structure and ways of life over millions and tens of millions of years. Paleontologists in particular have found it difficult to accept that the slow, continuous, and progressive changes postulated by Darwin can adequately explain the major reorganizations that have occurred between dominant groups of plants and animals (Carroll, 1997, pp. 8–9).

Darwinists have long tried to grapple with the question:

> Can changes in individual characters, such as the relative frequency of genes for light and dark wing color in moths adapting to industrial pollution, simply be multiplied over time to account for the origin of moths and butterflies within insects, the origin of insects from primitive arthropods, or the origin of arthropods from among primitive multicellular organisms? How can we explain the gradual evolution of entirely new structures, like the wings of bats, birds, and butterflies, when the function of a partially evolved wing is almost impossible to conceive? (Carroll, 1997, p. 8–9).

Carroll concludes that the "extremely irregular occupation of adaptive space" found in nature is "opposed to the nearly continuous spectrum of evolutionary change postulated by Darwin." In short, he argues:

> Although an almost incomprehensible number of species inhabit Earth today, they do not form a continuous spectrum of barely distinguishable intermediates. Instead, nearly all species can be recognized as belonging to a relatively limited number of clearly distinct major groups, with very few illustrating intermediate structures or ways of life. All of us can immediately recognize animals as being birds, turtles, insects, or jellyfish, and plants as conifers, ferns, or orchids. Even with millions of living species, there are only a very few that do not fit into readily recognizable taxonomic categories. Of all living mammals, only the tree shrews are difficult to classify. Are they primitive relatives of primates (our own distant relatives) or closer to the true shrews and moles among the insectivores? Even among the hundreds of thousands of recognized insect species, nearly all can be placed in one or another of the approximately thirty well-characterized orders (Carroll, 1997, p. 9).

Carroll (1997) then adds that evolution would lead us to expect "a very different pattern among extinct plants and animals" than what is found in the fossil record; namely, the fossil record "would be expected to show a continuous progression of slightly different forms linking all species and all major groups with one another in a nearly unbroken spectrum" (p. 9). In contrast, he notes what is found is "most well-preserved fossils are as readily classified in a relatively small number of major groups as are living species. Nearly all mammals that lived in North America and Europe during the past 50 million years can be classified among the seventeen living orders" (p. 9).

A major point to be considered is that creationists:

> who acknowledge the existence of *micro*evolution agree with proponents of *macro*evolution that natural selection does cause "evolutionary change." Indeed, much of the discussion of macroevolution in modern writings relates to *micro*evolution, which is discussed accurately from a scientific standpoint, but then is used as evidence for the "great leap" of extrapolation to *macro*evolution. The most extensive "leap" appears when evolution is elevated to *worldview status* as *evolutionism*. Evolutionism combines organic evolution, biological evolution, and societal evolution into one atheistic, naturalistic framework (Silvius, 1994, p. 341).

In a review of *Defending Evolution* (Alters and Alters, 2001), a book highly recommended "by such eminent evolutionists as Ernst Mayr and Stephen J. Gould ... [and] Eugenie C. Scott," Morris (2001) concludes that their defense of Darwinism fails because

> ...it focuses almost exclusively on defending microevolution (what creationists call adaptive variation), whereas it is only macroevolution that creationists reject in the first place. Essentially only three pages of the book (pp. 117–119) are devoted to defending macroevolution, and the concluding sentence of *this* section simply complains that it is "unreasonable" to expect observational evidence of macroevolution, since this does not follow the "normal procedures used in historical science research." That is true of course, but then why call it *science*? (p. 1).

A review of *most* books defending Darwinism reveals that they focus on, or even discuss solely, microevolution (for example see Weiner, 1994; Carroll, 1997). These books then imply (or even state) that because microevolution has been proven, macroevolution also has been proven. In the words of Niles Eldrege "microevolution proves macroevolution" (quoted in Witham, 2002, p. 97). This "bait and switch" approach, although a useful debating tactic, does not bridge the gap between the two different events. For this and other reasons, some feel that the terms micro- and macroevolution should be avoided, and that the expression "variations within the created kinds" is preferred instead of the term microevolution, while for macroevolution, the term "Darwinism" or "Neo-Darwinism" should be used.

Unfortunately, the terms micro- and macroevolution are widely used both by creationists and Darwinists, and therefore their replacement by any other terms will be very difficult. Another problem is that the term "evolution" usually is used by both Darwinists and creationists in both the professional and popular literature to mean macroevolution (such as in the phrase, "I don't believe in evolution"). Nonetheless, regardless of which terms we use, it is critical that we define our terms carefully in order to effectively communicate.

Summary

A review of the literature indicates that macroevolution is not simply microevolution extended. This study also indicates that explanations and evidence for microevolution cannot be used to support macroevolution. Microevolution and macroevolution can be differentiated by at least 17 different criteria, and probably more if an exhaustive review of the evidence were preformed (see Table I). These 17 criteria demonstrate that a major contrast exists between macroevolution and microevolution that cannot be bridged by time (Spetner, 1997). The definition preferred by the author is macroevolution involves *increasing* genetic information and, in contrast, microevolution involves duplication of and/or genetic recombination, transposition, or other rearrangements of *existing* information. Because microevolution also involves loss of information as a result of species or subspecies extinction, a dichotomy results. The fundamental differentiating trait of microevolution is the *loss* of information (which is well documented) and of macroevolution is a *gain* of information (for which no direct empirical evidence exists).

The conclusions here also agree with the basic conclusions presented at an important University of Chicago conference on macroevolution and microevolution involving the world's leading evolutionary biologists. A report on the conference concluded, in answer to the question can the "mechanisms underlying microevolution can be extrapolated to explain the phenomena of macroevolution," that "at the risk of doing violence to the positions of some of the people at the meeting, the answer can be given as a clear, No" (Lewin, 1980, p. 883). Macroevolution and microevolution involve two different processes, divided to the degree that the participants at the conference actually debated what would happen if "macroevolution is totally decoupled from microevolution" (Lewin, 1980, p. 883). Many conference presenters argued that evolutionary change is not continuous but "jerky." Francisco Ayala even concluded that he is "now convinced ... that small changes do not accumulate" to produce macroevolution (Lewin, 1980, p. 884).

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Book Review

Prey by Michael Crichton
Avon Books, New York 2002, 502 pages, $8

Author Crichton also wrote *Andromeda Strain* (1969), *Jurassic Park* (1991), and *Lost World* (1996). This latest bestseller and techno-thriller concerns nanotechnology, the nanometer scale of molecular motors, digital electronic components, and microrobotics. The latter topic is explained dramatically in *Prey*. The U.S. military contracts with a private firm to produce simple dust-size robots. Swarms of these floating specks are able to transmit composite pictures on the battlefield, similar to the compound eye of insects. The novel's tension begins quickly when the nanorobots escape the lab, become self-sustaining and self-reproducing, then commence to attack and choke people to death.

#1 NEW YORK TIMES BESTSELLER
MICHAEL CRICHTON
PREY
"TERRIFYING ... IRRESISTIBLY SUSPENSEFUL."
New York Times Book Review

The book gives extreme, continuous credit to evolution theory. The nanoparticles gain in intelligence by mutations, becoming more deadly hour by hour. They display predation, stalking, symbiosis, and altruism. Crichton compares his robotic swarm behavior with bird flocking and termite mound-building. Along with evolutionary propaganda, Crichton portrays corporations as evil, money-grabbing outfits which may well destroy us. This same theme appeared in *Jurassic Park*. The book ends with the total destruction of the Nevada lab which first produced the runaway nanorobots. This book is good recreational reading. However its excessive evolutionary overtones provide further life-support for a failed theory.

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Notes from the Panorama of Science

Extrapolations from Humphreys' Geomagnetic Data Reinforce His Young Earth Implications

In a recent CRSQ article, D. Russell Humphreys (2002) begins with a history of the "geomagnetic wars." He details Thomas Barnes' assertions that the earth's dipole or 1st order magnetic field is rapidly losing energy, implying a young earth. Next he reports a uniformitarian's response that the energy was not lost but merely shifted into the higher orders (harmonics) of the field. Humphreys then derives the energies in the 1st through 10th orders from the official data provided by the IAGA (International Association of Geomagnetism and Aeronomy). For the twentieth century, he calculates the difference between the energy increase in the 2nd through 10th orders and the energy decrease in the dipole. His results reinforce Barnes' assertion that the earth's total magnetic field is losing energy at a rate which implies a young earth.

One of Humphreys' data sets leads him to assert that from 1970 to 2000, "…the dipole lost 235 ± 5 PJ, whereas the non-dipole part gained only 129 ± 8 PJ." A PJ is a petajoule.

Humphreys definitely closed the issue to a great extent, but I believe there is still an open question. In response to Humphreys' quoted assertion, a critic could easily contend that since the 2nd through 10th orders of the earth's magnetic field account for 129 PJ of the dipole energy loss, then could not the 11th through infinity easily account for virtually all of the remaining 106 PJ? I do not know whether Humphreys is already working on this question.

In the following I will first discuss the feasibility of accurately completing the data set beyond the 10th order of the field. Then I will present a rough approximation which implies that orders 11 through infinity actually lost energy during the century, reinforcing Barnes' and Humphreys' conclusions.

Humphreys' energy equations depend on the Gauss coefficients such as those published by IAGA. So to complete the energy data set, we need to calculate those coefficients for arbitrarily high magnetic field orders—at least orders high enough that their energies meet some "vanishingly small" criterion. But is this feasible? Humphreys points out that his approach "does not account for electric currents in the mantle and magnetization in the crust" and that the latter "only affects harmonics higher than the tenth." The IAGA website gives similar reasons for truncating the coefficients at the 10th order (Mandea, 2000). Furthermore, the structure and mechanics of the mantle are still being debated even by uniformitarians (Tackley, 2000). Humphreys also discusses the fact that his energy equation contains a factor raised to the power of 2n + 1, "n" being the order, and that the higher order coefficient errors are thus magnified. Another set of calculated Gauss coefficients for orders up to the 19th are published on the web (Anonymous, 2000). Applying Humphreys' energy equations to the 1st through 10th orders for that dataset produces virtually the same numbers as his Table II. However, the energies for the 11th through 19th orders grow exponentially, so that the 19th order has an energy almost twice that of the dipole! This is clearly in error. Thus it appears that accurately calculating the coefficients above the 10th order requires more accurate models and measurements than currently exist.

If the higher order Gauss coefficients cannot be calculated, then they must be extrapolated—a questionable process. However, the "signal" formed by the energies in the various orders might be amenable to mathematical representation. Figure 1 is a graph of the 10 order energies averaged over the entire century to smooth out errors as well as the 1945/1950 "pulse" described by Humphreys. The results

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clearly fall into a well-known class of real-world signals, i.e., those that are often approximated (very roughly) by the absolute value of the "sinc" signal, f(x) = (sin πx) / πx.

Note that the dipole lies at the center of the main lobe, while orders 2 through 5 sample the first sidelobe, etc. (Subsequent sidelobes can only be seen by stretching the graph vertically, as in Figure 2.) The "sinc" class of signals turns up in antenna patterns in radar applications, as well as in Fourier transforms in digital and analog signal processing, and has been studied profusely. Such signals lend themselves well to Fourier analysis, so that reasonably accurate extrapolation might be possible. I have the MatLab (Matrix Laboratory) computer program which should do the job nicely. However, as this approach is both non-trivial

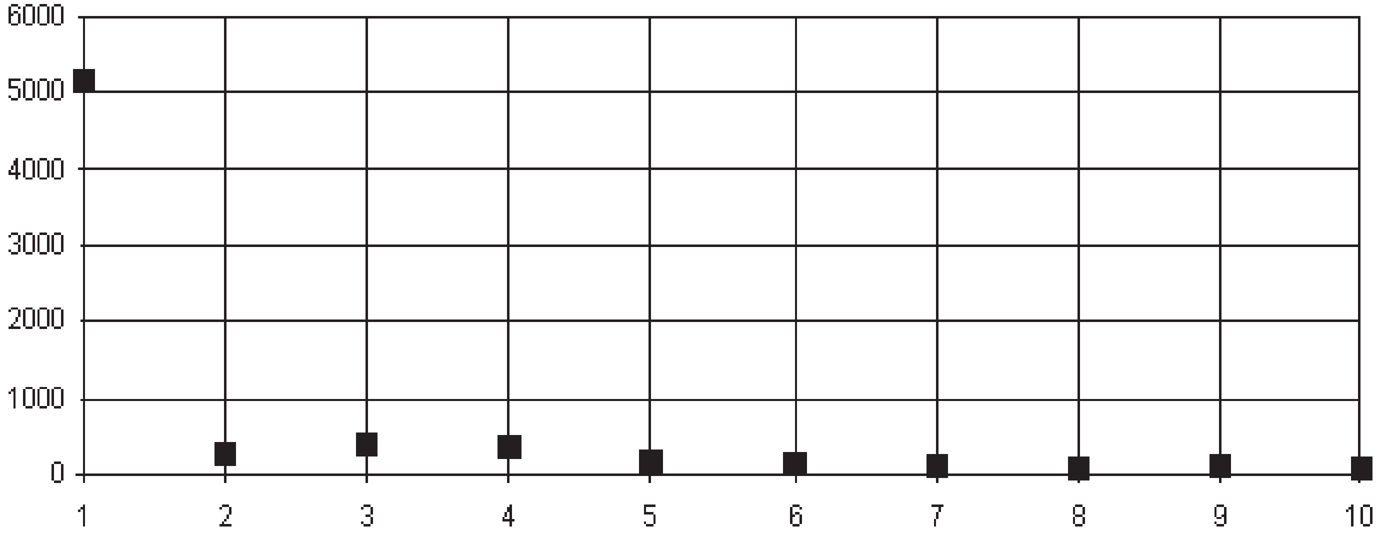

Figure 1

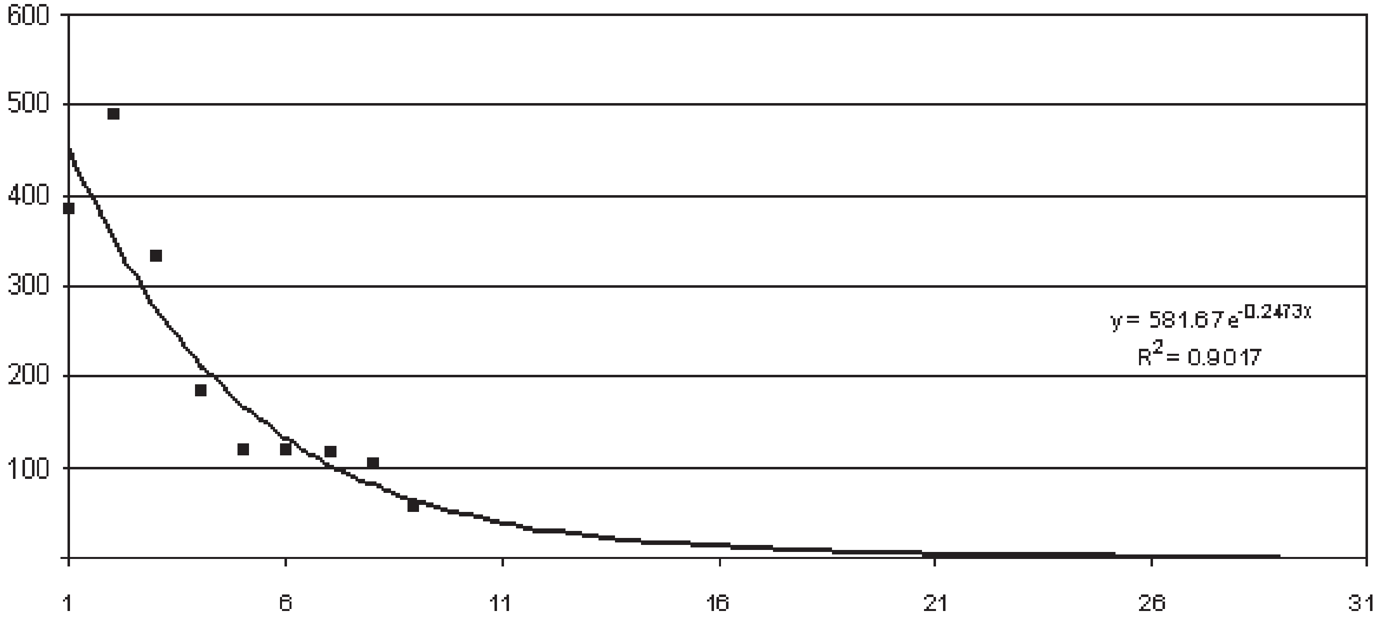

Figure 2

and of questionable value, I will defer to Humphreys before taking that direction.

In the following I have taken a much simpler approach, though arguably even more questionable. I use an exponential trendline based on the 2nd through 10th order energies, as provided in a spreadsheet program, to approximate the energy in the orders 11 through infinity. This rough though reasonable approximation demonstrates that in all likelihood, the total energy in orders 11 through infinity of the earth's magnetic field is decreasing with time.

Figure 2 is a graph of the non-dipole energies for the 2nd through 10th orders of the field for the year 2000 from Humphreys' Table II. (The energy for order 2 appears at x = 1 because the dipole, order 1, has been removed). Also in the graph appears a least squares exponential trendline provided by the spreadsheet program. The trendline is extended to show that the energy probably becomes vanishingly small for orders above about 25 or 30. The graphs for years other than 2000 are very similar, so they are not shown here. There are 20 more such graphs and they can be easily recreated directly from Humphreys' Table II. The mathematical form of the trendline for year 2000 is given on the graph along with the R-Square value, also provided by the spreadsheet program, which is a confidence indicator for the exponential fit to the raw data. The R-Square value for this particular trendline is 0.9017. An R-Square of 1.0 is a perfect fit and a value of 0.0 is the worst possible fit.

Figure 3 graphs the R-Square values for the entire century, and together with Figure 2 indicates that, with the exception of the 1945/1950 "pulse," the exponential fit is excellent, especially for the years 1970 through 2000, where the IAGA raw data is more accurate.

Next we get the approximate total energy in orders 11 through infinity for each 5-year period by integrating its exponential trendline equation from 10 (not 11 since we have removed the dipole) to infinity, which for negative 'a' produces:

$$\int_{10}^{\infty} Me^{ax}\,dx = -Me^{10a}/a$$

The 'M' and 'a' values in the integral are taken from the trendline equations for each 5-year period, only one of which was shown in Figure 2. Figure 4 graphs the results of the integrals for the entire century. There is clearly a decreasing trend, except of course for the 1945/1950 "pulse" where the R-Square values show that the exponential fit breaks down.

Let us clarify exactly what is being graphed. Figure 2 graphs the numbers in Humphreys' Table II, from the column marked "2000," and the rows from "Quadrupole E" through "10th Harmonic." Note that the energy trend with time moves along a row in Humphreys' table, whereas the energy trend with order moves along a column in that same table. Here we are extrapolating along each of his columns using a least-squares exponential trendline, or curve fit, and looking at how those extrapolations change over the years 1900 to 2000. The extrapolations get smaller with time (Figure 4), implying that if our method is reasonable, then the energy in the magnetic field orders which Humphreys did not address, the 11th through infinity, is decreasing with time.

Is the decreasing energy trend (with time, i.e., along a table row) an artifact of arbitrarily choosing an exponential extrapolation (with order, i.e., along a table column)?

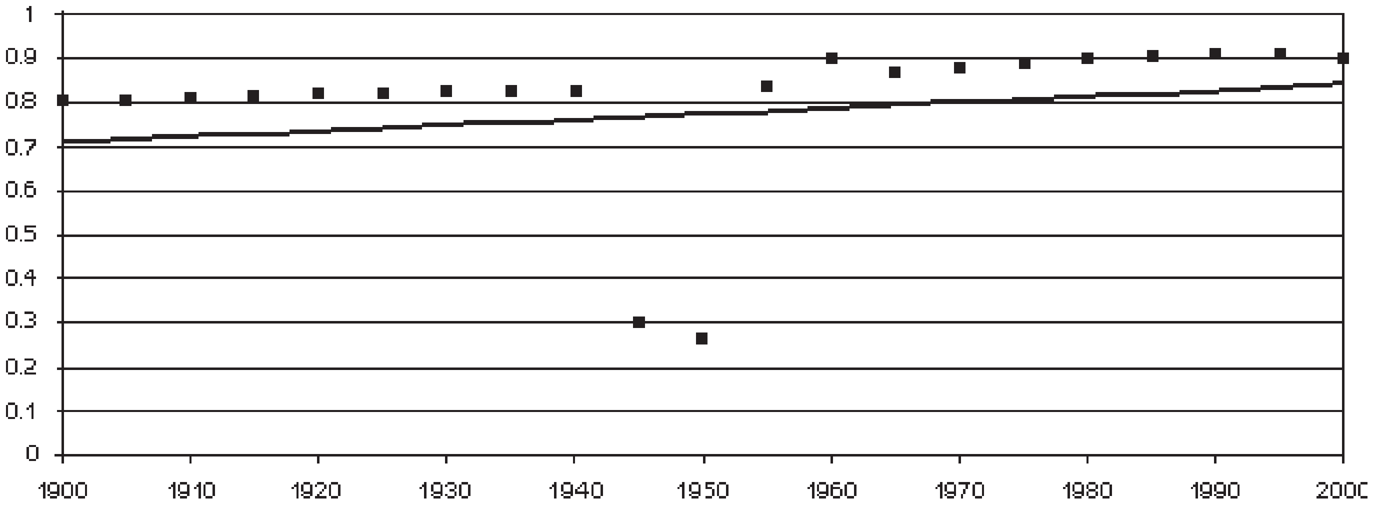

Figure 3

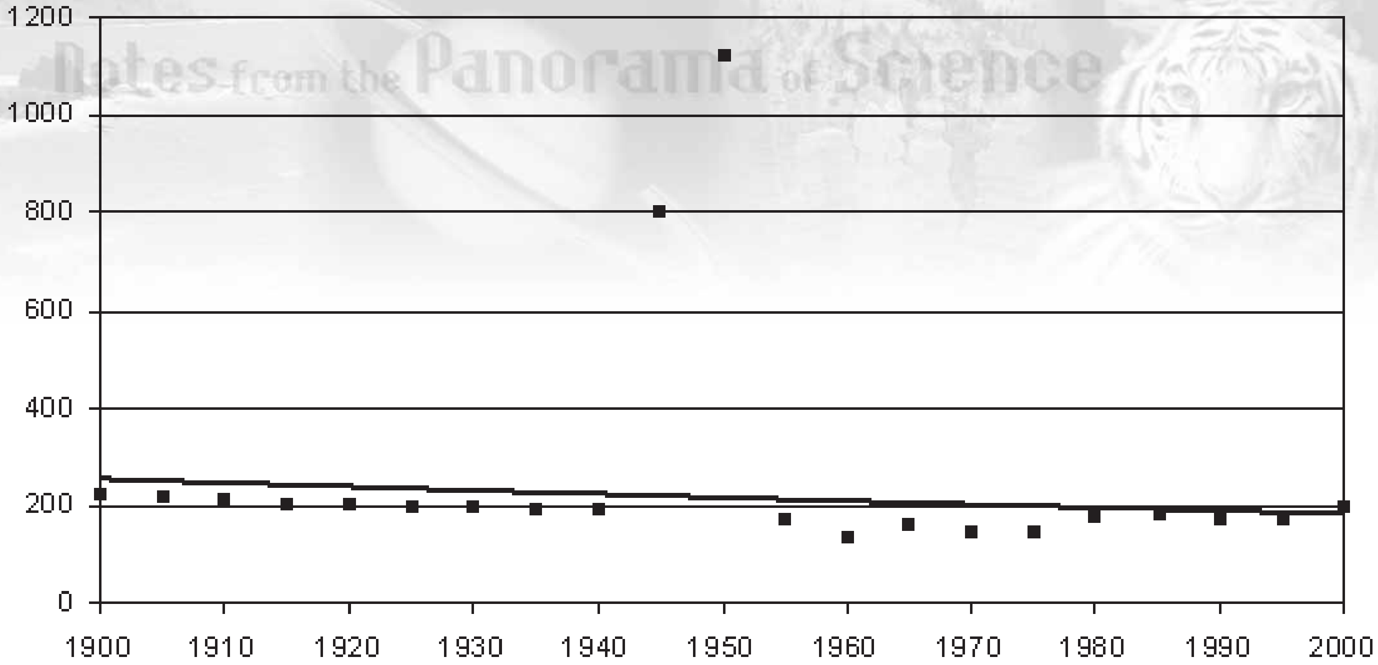

Figure 4

Not at all. However, it is caused by a combination of that choice and another trend in Humphreys' data. Note that in Humphreys' Table II, the lower non-dipole orders, e.g. the quadrupole and octopole, grow much faster than the higher orders. For example, the quadrupole essentially doubles over the century while the 10th order only grows by about 5%. The faster growth in the lower orders forces the absolute value of "a" in "-Me^{10a}/a" to go higher in each succeeding 5-year period, driving the higher orders toward zero with time, and thus producing the decreasing energy trend with time. The question that a critic of my approach should ask is: "Is an exponential function an arbitrary choice or a reasonable expectation for the signal in Figure 2?". I think it is reasonable, especially since the confidence values (R-Square) for the trendlines are so high, as shown in Figure 3.

Furthermore, the faster growth in the lower order energies in Humphreys' Table II implies something independent of the choice of function for the extrapolation. Even if more accurate raw data were someday produced which indicated that the orders above the 10th increase in energy with time, the current data implies that their increase would be miniscule compared to the increase in the lower orders. Thus, since Humphreys indicated that the increase in the 2nd through 10th orders cannot account for the dipole loss, it is highly unlikely that the addition of the higher orders could account for it either.

These results imply that if more accurate data beyond the 10th order of the earth's magnetic field were obtainable, they would most likely show that the field is losing energy. The rate at which that loss occurs is probably very close to that asserted by Humphreys, adding further support to his claim that the earth is only a few thousand years old.

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Could Fossil *Homo sapiens* from Spain Provide Answers to the Past?

Perhaps *Homo sapiens* fossils from Spain may help provide answers concerning which type of fossil man comes “first” in the record (Arsuaga, Martinez, Gracia, Carretero, and Carbonell, 1993). After telling readers that these particular skulls fit well within the range of *Homo sapiens*, the authors then state that the skulls are well differentiated from the *Homo erectus* group in Asia (p. 534). The *Homo erectus* skulls from Asia and those *Homo sapiens* from Spain using the evolutionary dating scale are both 300,000 years old. The fact that these *Homo sapiens* skulls from Spain are not like these *Homo erectus* skulls at this same age means that they are going to be even further removed from the *Homo erectus* skulls of Pekin and Java, which are some 500,000 to 700,000 years old on the evolutionary dating scale. The Steinheim and Swanscombe skulls are both *Homo sapiens*, occurring at the same time (300,000 years). The oldest *Homo sapiens* spears are 400,000 years old, if not older, on the evolutionary dating scale. Likewise, spears attributed to *Homo sapiens* were found in Germany (Dennell, 1997).

There are several possible ways in which *Homo sapiens* and *Homo erectus* may have been connected: (1) *Homo erectus* may have come first and may have given rise to the *Homo sapiens* specimens that possess elongated skulls; and the latter, in turn, may gave given rise to modern *Homo sapiens*. (2) *Homo sapiens* with elongated skulls may have given rise to *Homo erectus* via one line and to modern *Homo sapiens* by way of a separate line. (3) *Modern Homo sapiens* may have given rise to the *Homo sapiens* that have elongated skulls, and these, in turn, might have produced a line leading to *Homo erectus*.

With as little light we have from these skulls from Spain (Arsuaga, et al., 1993), we at present have no clear indication that *Homo erectus* gave rise to the *Homo sapiens* individuals having elongated skulls. So, from about 2 million years in Africa, 700,000–500,000 years in Java, 500,000 years in Pekin, and up to the 300,000 years in Asia, these *Homo sapiens* skulls from Spain are clearly differentiated from all the *Homo erectus* skulls and may have no connection with them. Since the *Homo erectus* skulls from Europe are similar to those in Asia, these findings raise questions about whether or not there is any connection between *Homo erectus* and *Homo sapiens*.

An item, in the same issue as Arsuaga et al., Stringer (1993, pp. 501–503) places all European skulls including those from Spain into one of two groups: (1) Either modern or archaic *Homo sapiens* or (2) *Homo sapiens* and *Homo neanderthalensis*. Many put *Homo neanderthalensis* as a sub-species or race of *Homo sapiens*. These fossils leave us with the strong possibility that *Homo sapiens* actually gave rise to *Homo erectus*, the reverse of conventional ideology.

There are a number of fossil remains that have had their dates changed by evolutionists, which if they were left at their original dates would have given further support to the view that *Homo sapiens* was the progenitor or *Homo erectus*. Every now and then we get a glimpse of light which, on the face of it, shows the evolutionary theory to be on the wrong footing. [Editor’s note: While Mr. Brown prefers to work with the evolutionary ages of fossils in developing his possible lines of connection between extinct forms, the position of *CRSQ* is that all creation occurred more recently than these “ages” would suggest.]

Acknowledgments

I wish to thank George Howe for editorial assistance and Benjie Osmanson for computer typing involved in preparing this letter.

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The extreme rarity of transitional forms in the fossil record persists as the trade secret of paleontology. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of the branches; the rest is inference, however, reasonable, not the evidence of fossils.

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Rethinking DNA Similarities between Chimps and People: "No Time" to Evolve Humans from Australopithecines

For a number of years now we have been told that the DNA of chimp and human have been up to and over 99 percent the same depending on which item you read. Now we are told that all of this is wrong because there is need to drop this similarity figure by 5 percent bringing it down to 95 percent (Coghlan, 2002, p.20).

The so-called common ancestor of chimp and human has long been said to have lived some 7 million years ago, but a recent discovery raises serious doubts. In Wood (2002) we are told that a fossil called *Sahelanthropus tchadensis* looks from the back of the skull like a chimp, but the face is like that of an *Australopithecus* from 1.7 million years ago. At this stage fossils should have been starting to show only a few signs of being hominids and should not have had a face of a hominid (*Australopithecus*) which is supposedly less than one-third of its geological age. This fossil plays havoc we are told with the one line of descent model from a common ancestor. So, evolutionists assert that anything can pop up at almost any time in order to help cope with appearances of fossil forms like this one; and this is desperate stuff!

We know that chimps are non-human, and this 7 million year old fossil was chimp-like from the back and the face having the same Australopithecine pattern that was seen in fossils right up to 5.5 million years later (1.5 million years ago) when the last Australopithecine fossil is recorded. This means that Australopithecines were non-human all the way through theoretical "geologic time."

To add to all of this, a fossil *Australopithecus africanus* from Sterkfontein known years ago as "Mrs Pleas" and now known as "little foot," was once dated at 3.5 million years old, but is now put more recently at 2.4 million years (Eartherley, 2002, p. 13). The other interesting thing about the 2.4 million year old date is that "little foot" is viewed by evolutionists to be too young to be on the human line. It is, therefore, only a cousin of man and not an ancestor. The hypothetical date of 2.4 million years for "little foot" is also of interest, because finding a fossil at 2.4 million years of a form that is more advanced than the Australopithecines would be a near death blow for the theory of evolution. But we know that *Homo erectus* skulls have been found in Dmanisi George and are assumed to be 1.7 million years old. Therefore *Homo erectus* must go back to and likely beyond the 2 million year mark. Back to 1.9 million assumed years in Africa and in the Middle East hand axes were found (Calder, 1984, p.11). We must conclude that *Homo erectus* goes back before the 2 million year mark and thus becomes almost contemporary with *Australopithicus*, its supposed ancestor. This casts serious doubt on the whole theory of evolution altogether.

Acknowledgments
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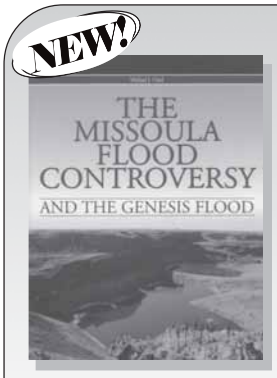

NEW!

The Missoula Flood Controversy and the Genesis Flood

by Michael J. Oard

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One of the most spectacular floods in prehistoric times, besides the Genesis Flood, was the great Lake Missoula flood, which left its mark in the Channeled Scabland of the Pacific Northwest in the United States. However, the evidence was the subject of intense controversy for 40 years before being accepted. In this book, Michael Oard discusses not only the abundant evidence, which at the time was considered to be "too biblical," but also the circumstances surrounding the controversy.

A chapter is dedicated to other ice age floods, and evidence of the Genesis Flood is presented, consisting generally of new information from the field of geomorphology. Another chapter is devoted to a defense of the short time scale of Scripture.

Time Warp III: The Proterozoic-Paleozoic Hiatus in the Northern Midcontinent

As documented in previous parts of this series, time is more of a dilemma for uniformitarians than for creationists. That is because consistent naturalism demands a strict positivist method—one which is singularly ill suited for historical study (Reed, 2001). Where there is no field documentation of a particular span of time in the rock record, then that time can only be inferred or assumed—a "time warp." Often, field evidence suggesting depositional continuity is at odds with a biostratigraphic hiatus (Reed, 2002).

A spectacular example is found in the hiatus between the Proterozoic Midcontinent Rift System (MRS) volcanics, sediments, and structures and the oldest overlying Paleozoic sediments. Cannon (1994) presents the MRS chronology of events by reference to radiometric dates, and defines the final stage of compressional and reverse faulting between 1060 Ma and 1045 Ma. Since the Cambrian transgression and basal Phanerozoic sedimentation are defined at approximately 500 Ma, there exists a hiatus of more than 500,000,000 years between the latest events of the MRS and the earliest events of the Phanerozoic. This time interval is not represented by any positive feature of the rock record in the region surrounding the MRS. To place this timewarp in perspective, the hiatus is almost the same duration as the entire Phanerozoic, which represents the vast majority of the regional sedimentary record.

Defining the Timewarp

The youngest Proterozoic rocks in the region are those of the Midcontinent Rift System (MRS). Figure 1 shows the sequence of events that uniformitarian researchers have developed to explain the timing of the development of the MRS. Most researchers now accept a generally synchronous development of the MRS from similar Rb-Sr dates of volcanics in the northern and southern parts of the rift (Berendsen et al., 1990), and the compatibility of U-Pb Zircon dates from the Lake Superior Basin and Kansas (Van Schmus, 1992). Allen et al. (1997) use magnetic stratigraphy to note that rapid volcanism apparently initiated under eastern Lake Superior and migrated westward. Following volcanism, sediments from both eroding volcanics and the surrounding granitic craton were deposited in basins atop the subsiding volcanics. Then, the structure inverted and large reverse faults formed, creating an uplifted horst of mostly igneous rocks. Sediments were deposited in half grabens formed by these faults. As shown in Figure 1, the

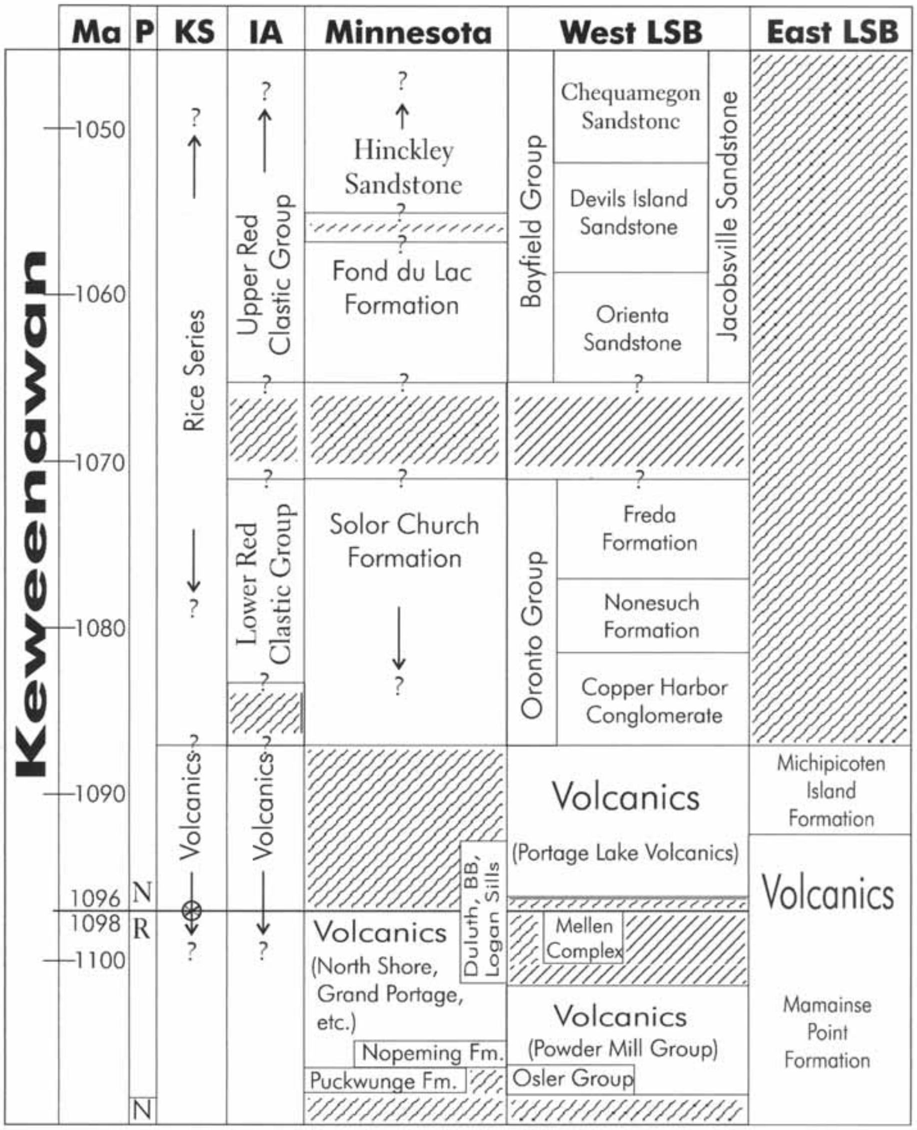

Figure 1. Stratigraphic Chart of Proterozoic Midcontinent Rift Rocks in central North America. From Reed (2000). "P" is magnetic polarity, KS is Kansas, IA is Iowa, and "LSB" is Lake Superior Basin.

latest documented strata at the MRS are around 1045 Ma. Additional discussion of the development of the MRS is found in Reed (2000).

The earliest Cambrian rocks in the northern midcontinent are sandstones overlying the granitic basement and MRS. They are estimated to be approximately 500 Ma and younger, and are known as the Regan, Lamotte, or Mt. Simon sandstones (among others) depending on the locale. Absolute dating of the hiatus between the latest MRS events and the earliest Paleozoic transgression requires more than 500,000,000 years. However, there is no field evidence of any geologic activity between the Bayfield (latest MRS sediments) and Cambrian sediments along the MRS, and only erosion between the Cambrian sediments and the volcanics of the MRS and the cratonic basement. Of course, erosion leaves no evidence that constrains its timing. Thus, the only evidence for the gap between the MRS and Cambrian sediments are the radiometric dates along the MRS and the biostratigraphic dating of the Cambrian transgression in the midcontinent. If evolution has not happened and isotopic dating is not reliable, then there is no positive evidence for the missing time.

Problems Presented by this Timewarp

One problem created for uniformitarians by this "dead time" requires an appreciation of the uniformitarian framework. This framework is often thought of in terms of relating the present to some point in the past. What is often not considered is the corollary pointed out by Reed (2001) of the logical requirement for a Principle of Temporal Invariability. If the present is the key to the past at any particular point in the past, then it must be the key at every point. The principle of identity then forces every point in the past to share exactly the same qualities under question not only with the present, but also with *each other*. Thus, the challenge of the rock record for uniformitarianism is twofold. Not only must everything seen in the rock record be readily understood by present processes, but there must be continuity of these processes at all times in the past. If not, the chain of explanation is broken and understanding history within the limits of naturalism and its handmaid, positivism is impossible.

1240 to 1160 Ma	Grenville Elzeverian Orogeny
1109 to 1094 Ma	Initial extension and volcanism
1094 to 1084 Ma	Late volcanism; deposition of redbeds; diminished subsidence
1090 to 1025 Ma	Grenville Ottawan orogeny
1086 Ma	Latest volcanism prior to thrusting
1080 Ma	Possible earliest thrusting
1060 to 1045 Ma	Formation of present horst and basin structure

Empirical necessity has driven modern geologists away from a logically consistent formulation of uniformitarianism and back to the historically biblical principle of uniformity. But how can a naturalist affirm uniformity other than by a leap of faith into the dark? Christians are quite comfortable with uniformity because they worship the God who is "…infinite, eternal, and unchanging" (Williamson, 1964). Naturalists have no God and thus cannot justify their use of uniformity within their own worldview. In this context, the timing of events in the North American Midcontinent present a significant philosophical challenge to uniformitarianism. The MRS illustrates the empirical failure of this logical requirement by demonstrating a lack of continuity between the events preceding the MRS, those during its formation, and those succeeding it.

Sediments deposited at the end of the MRS event are classified as non-marine (Van Schmus and Hinze, 1985) because of their mineralogical makeup, the lack of fossils, and the absence of associated marine beds. Thus, the physical rock record does not record any marine transgression during the events of the MRS or in the 500,000,000 year hiatus between the MRS and the Phanerozoic. Yet the same time interval of the Phanerozoic records at least six major transgressive-regressive cycles in the Midcontinent (Sloss, 1963). What changed? Can we really understand it by reference to present observed processes?

Similarly, evidence for plate tectonic cycles predicted by Hoffman (1989), and referenced by Anderson (1990b) and Van Schmus et al. (1993) is missing. This concept predicts cycles of crustal evolution every 200–300 million years when the accumulation of heat under thick continental crust causes a new tectonic cycle. If the MRS is the result of one of these cycles, then why are not others observed in the 500,000,000 hiatus? It would appear that this region would be conducive to repeated tectonic cycles, since the post-rift continental crust was abnormally thick (Halls, 1982) in this region, and the MRS includes a zone of deep faulting that could have been easily reactivated in a new cycle (Cannon, 1994).

Another facet of this problem is found in the presence of structural deformation of Paleozoic strata by MRS struc-

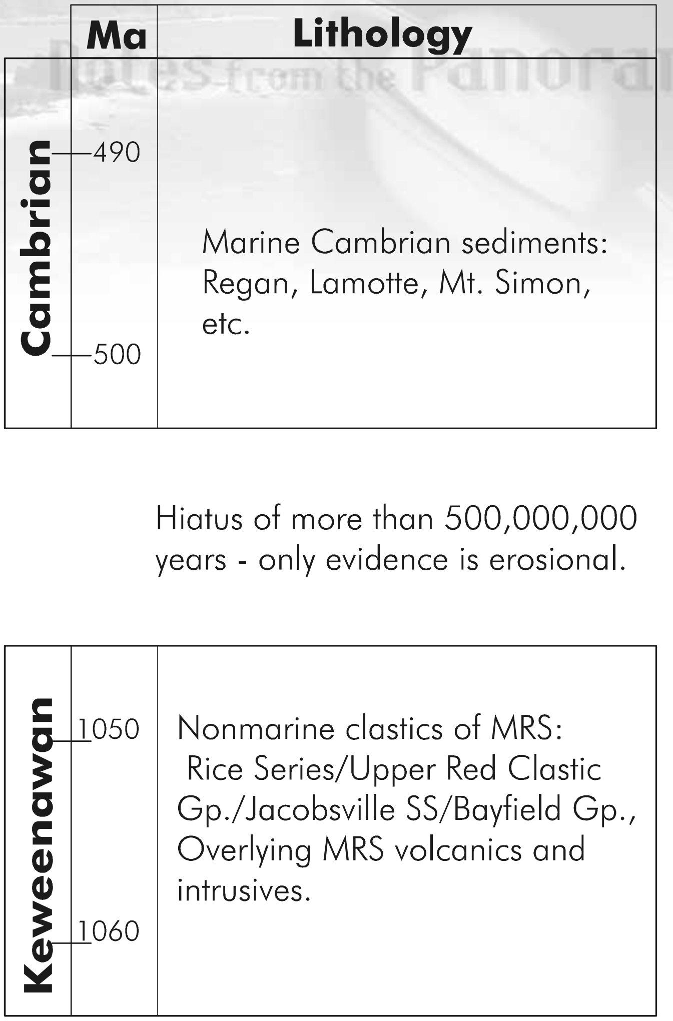
Ma
Lithology
Cambrian
490
500
Marine Cambrian sediments: Regan, Lamotte, Mt. Simon, etc.
Hiatus of more than 500,000,000 years - only evidence is erosional.
Keweenawan
1050
1060
Nonmarine clastics of MRS: Rice Series/Upper Red Clastic Gp./Jacobsville SS/Bayfield Gp., Overlying MRS volcanics and intrusives.

Figure 2. Timewarp between Proterozoic Midcontinent Rift and Cambrian marine sediments.

tural features (Reed, 2000, Table XVI). Many of the MRS faults deform Paleozoic sediments. These include the Belle Plaine Fault System, the Thurman-Redfield Fault, and the Northern Boundary Zone fault. Interestingly enough, modern seismicity is reported in Kansas along the Nemaha anticline (Steeples et al., 1979), a feature of uncertain origin but linked to the MRS in Kansas (Berendsen, 1997). This phenomenon is explained away by reference to the "reactivation" of older structural features. However, there is no evidence supplied to demonstrate that the "reactivation" supposedly happening hundreds of millions of years later was not associated with the same deformation revealed by MRS sediments. It is certainly fair to ask why.

The apparent relationship between Paleozoic basins and underlying MRS basins also raises questions about the existence of the necessary time between them. Do the Paleozoic basins represent the separate superimposed basins, or are they evidence for continuing activity that implies the nonexistence of the proposed 500,000,000 year hiatus? Examples include the pre-Paleozoic and Paleozoic Twin Cities basins, the Proterozoic Emerald Basin (Allen et al., 1997) and overlying Paleozoic River Falls Syncline, the Proterozoic Mineola Basin and overlying Pennsylvanian Glenwood Syncline, the Michigan segment of the MRS and the Paleozoic Michigan Basin, the Nebraska-Kansas segments of the MRS and the Paleozoic Salina and Forest City Basins (Carlson, 1997).

Conclusion

It appears that the uniformitarian interpretation of Proterozoic and later events in the upper Midcontinent region includes a period of intense deformation, volcanism, and sedimentation forming the MRS, followed by more than 500,000,000 years of no discernible activity, followed by 500,000,000 years of sedimentation, erosion, and structuring. Given this discontinuity, and given the logical corollary of temporal invariability, then it appears that uniformitarianism is not a helpful framework for interpretation here. If one needed to depend on empirical observation, then the hiatus presents a problem for any interpretation that depends upon a logically consistent application of uniformitarianism in the naturalist worldview.

That the interpretation of the events of the MRS can be referenced to observed present-day processes is highly questionable at all. If the catastrophic interpretation of the MRS (Reed, 2000) is correct, then there is obviously no present day process remotely resembling it. But an even more pointed challenge to uniformitarians is to explain how a region undergoing such a singular event would then (based on the physical evidence) remain totally quiescent for more than 500,000,000 years, almost the duration of the entire Phanerozoic era. Such an assertion staggers the imagination. It is no wonder that uniformitarians delicately refer to this missing time as a problem. For example, Catacosinos (1981) called the hiatus Michigan's "lost era". At that time his estimate of the hiatus was almost 100,000,000 years shorter than current researchers. Of course, the uniformitarian reply that these millions upon millions of years of geologic activity simply left no record is a classic argument from lack of evidence. A better answer might be that they never existed at all.

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Book Review

The Never-Ending Story by Antonio Lazcano
American Scientist, 2003, 91:452–455.

Antonio Lazcano recently reviewed three newly published books on the topic of how life might have arisen by evolution. Dr. Lazcano is highly qualified for this task because he is the current (2004) president of ISSOL (The International Society for the Study of Evolution and the Origin of

Life). On 7 April 2000, at Schoenberg Hall, UCLA, he was one of the keynote speakers at a conference held under the aegis of CSEOL, which is the Center for the Study of Evolution and the Origin of Life, a conference that I happened to attend.

CSEOL's headquarters is located on the fifth floor of the Charles E. Young Geology Building at UCLA. It involves a seminar room, library, reading room, and various laboratory facilities that are all available to CSEOL members. Dozens of UCLA professors in science, engineering, and other fields are CESOL members. CESOL publishes a journal: *Origins of Life and Evolution of the Biosphere.* Particulars concerning the journal and CESOL membership are available from Dr. J. William Schopf, prime mover in CESOL since its inception in 1985: schopf@ess.ucla.edu.

Antonio Lazcano is one of the best known and most highly respected of all Mexican biologists, and he is a close friend of Stanley Miller. He is a Distinguished Professor at Mexico's Autonomous National University where he is renown as a researcher, teacher, and widely acclaimed popular lecturer on the origin and early evolution of life.

Lazcano is also known for his frankness in assessing the current status of origins research—witness the title of his review!

He began with Albert Camus' reference to the mythological Sisyphus whom the gods had condemned. As the worst possible punishment, they forced Sisyphus to roll a rock to the top of a mountain, "…whence the stone would fall back on its own weight," wrote Camus. Sisyphus then had to roll it back to the top once more and watch it again fall back—a chastisement that was to go on forever! About the gods themselves, Camus stated: "They had thought with some reason that there is no more dreadful punishment than futile and hopeless labor." [Note, this and all other quotations used here are from p. 452 of the above review.]

Lazcano applied this myth to the origin of life researchers who have adopted various schemes, only to find them become, one by one, ultimately unworkable—requiring that their research be started all over again. Several of these false starts which Lazcano discusses in the introduction of his review are: (1) the amino acid studies of Miller, (2) the self-catalytic RNA theory, (3) the paleontological evidence which supposedly showed life in the earliest Archaean times, and (4) the idea that the nuclear material for the first type of eukaryote cell on earth was derived from archaebacteria.

Concerning the Miller work, Lazcano writes: "…but nowadays geoscientists tend to doubt that the conditions of the prebiotic environment were as reducing as Miller and others had assumed." With regard to the possibility that self-catalyzing RNA would solve the chicken-egg problem of which one came first—DNA, RNA, or protein; Lazcano indicates that "…it is now generally accepted that RNA is a frail polymer unlikely to have undergone prebiotic synthesis and accumulation." Third, he notes that "…several authors have contested the biological origin of the structures and chemical signatures described in the early Archaean Australian Warrawoona formation and the similarly ancient Akilia island rocks, respectively." Finally he had this to say about a possible archaebacterial source for nucleocytoplasm:

> …the molecular traits that eukaryotes and heat-loving extremophiles share appeared initially to point toward an archaebacterial origin for the nucleocytoplasm, but as more and more completely sequenced cellular genomes have become available, their analysis has shown that an extreme amount of horizontal transfer of genes occurred, leading many to wonder whether we will ever untangle the web-like phylogenies of early cell evolution.

In his triple-header review, Lazcano goes on to evaluate the work of each author in a positive and forthright manner, as one might expect. The very idea, however, that he would start with this healthy dose of introspection about the progress of previous origin of life researches is commendable. In a field which lies far outside the domain of empirical science (how life might have arisen by chance in supposed eons past), it is encouraging to read words like these from one who is at the helm of ISSOL.

I believe creation scientists ought to be grateful for the more than 50 years of research done by evolutionists on this topic. With diligence, intelligence, and plenty of cash each in his turn has tried to demonstrate the likelihood of the natural abiogenesis of cells. To return to the mythological story told by Camus, the find that emerges from their mountain of experimental data, however, is that it requires considerable experimental design to produce even the simplest "building blocks" of macromolecules, let alone primitive cells. Perhaps in the end, the modern-day counterparts of Sisyphus will return gratefully to supernaturalism, which has been standing as the basis of the true origins mountain all this time!

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Letters to the Editor

Tunneling Between the Stars

Quantum tunneling may help solve the distant star light problem since the transit time across a tunneling barrier is constant regardless of its thickness. If light were to tunnel across much of interstellar and intergalactic space, its travel time between the stars would be greatly reduced.

Tunneling between stars would be detectable by stellar and galactic observations.

A star coming out from behind a tunneling barrier would disappear as it passes the barrier's edge, because the light would take time to cross the barrier's thickness at the speed of light. In a long exposure image the star could appear dimmer than usual since less light reached the camera.

A star passing behind a tunneling barrier would produce a double image for a time since the tunneling light would reach the observer before the light emitted by the star just before it reached the barrier's edge. In some cases the two images would be close enough to produce an elongation of the star image. Some examples of this involving galaxies may have been interpreted as gravitational lenses.

While this idea is not yet a working theory, tunneling is a potential tool for dealing with the distant star light problem.

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Regarding the "Forum on Dinosaur Eggs, Nests, and Tracks"

I have mixed feeling about the wisdom of a new feature found in the September 2003 issue of the *Creation Research Society Quarterly*, the "Forum on Dinosaur Eggs, Nests, and Tracks." On the one hand I think that it may prove to be a popular feature. On the other hand I am afraid that it will not benefit the cause of the Creation Research Society. "The chief purpose of this organization shall be to publish research evidence supporting the thesis that the material universe, including plants, animals and humans, is the result of direct creative acts by a personal God." (CRS Constitution, Article I, Section 2) I also believe it will become divisive with writers playing fast and loose with both scripture and the processes and models of geology in order to prove or justify their particular conception of the history of the earth and the living things found on it today.

What follows is not to be taken as an attack on the authors of the first two position papers. I am acquainted with two of them and do not question their integrity, commitment to the cause of creationism, their faith in Jesus, the Christ of the Bible, or their scholarship. I am using parts of these articles to illustrate certain pitfalls to avoid when defending one's intellectual property. I hope that others will learn to recognize these pitfalls in their work and strive to avoid them. These pitfalls can be classified into two groups. 1. Giving worldly wisdom the same weight as Godly wisdom. 2. Putting words into God's mouth where God has not spoken.

I submit the words of St. Paul to the Colossians for the consideration of my fellow Christians in the CRS. "Since you died with Christ to the basic principles of this world, why, as though you still belonged to it, do you submit to its rules?" (Col. 2:20 NIV) I believe that the worldly rule in the sciences is, "Interpret all evidence in the light of natural processes, any supernatural explanation is unacceptable." To do this you must use presently accepted scientific models and obey the principles of worldly historical geology which are:

1. The principle of original horizontality.
2. The principle of super position.
3. The principle of cross cutting relationships.
4. The principle of fauna succession.
5. The principle that the present is the key to the past.

In addition to these there is the unwritten and untaught principle, "Do whatever you can to convince your audience that you are right." Which means you may misquote or misparaphrase the authorities you cite to your advantage, down play the discordant evidence and over play the importance of concordant evidence, cite only those principles that favor your thesis, and declare a principle not applicable when it is used against your thesis.

I think that words are put into God's mouth when His words are exaggerated or doubted. I am disturbed when I read the Bible quoted, "... on that day all the fountains of the great deep were broken up, and the windows of the heavens were opened. And the rain was on the earth forty days and forty night," (Genesis 7:11–12 New KJV) and in the next paragraph read the words, "The sky continually poured down torrential rains for 40 solid days. Huge water reserves under the earth are released" (Lain, p. 118) Edward C. Lain and Robert E. Gentet are not the first in creationist literature to use this language to support their conclusions. I am disturbed when my colleagues add to what is in the Bible, no matter how reasonable or slight the addition is and then support their conclusions by citing the additions.

I think words are put into God's mouth when human ideas assumptions are made when God's word is silent. Michael J. Oard (p. 120) writes, "Since tracks and eggs are activities of live dinosaurs, there are only three possibilities: They are either pre-Flood, early Flood, or post-Flood." This is reasonable in mind of the world. Who says dinosaurs were alive at the time of the Flood or, for that matter, ever were alive? If we do not make this assumption there can be a fourth possibility. God could have created them during creation week. To rule out this possibility because it does not follow the principles and rules of this world should cause one to ponder what God says through the prophet Isaiah. "For my thoughts are not your thoughts, neither are your ways my ways," declares the LORD. "As the heavens are higher than the earth, so are my ways higher than your ways and my thoughts than your thoughts." (Isa. 55:8–9 NIV)

Later on Oard (p. 120) writes, "Since tracks and eggs are often found on top of a few thousand meters of sedimentary rock, it is not likely they are pre-Flood, since these sedimentary rocks are Flood rocks." How does Oard know this? The Bible is silent on when and how sedimentary rock came to be and nowhere in Genesis 7 and 8 are sedimentary rock mentioned. If sedimentary rocks are not Flood rocks, then these fossils could be pre-Flood and Oard's subsequent arguments are weakened.

My friends, I think the above are samples of following the rules and principles of this world. I plead with flood geologists and other creation scientists writing for publication in this journal to keep in mind, "The chief purpose of this organization shall be to publish research evidence supporting the thesis that the material universe, including plants, animals and humans, is the result of *direct creative acts* by a personal God." (CRS Constitution, Article I, Section 2 emphasis added)

Now let me comment specifically on the articles under discussion. Lain and Gentet (2003) ask, "Dinosaur Eggs, Nests, and Tracks: Evidence for or against the Noachian Flood?" My impression is that the authors think these fossils are pre-Flood. If one uses the wisdom of this world, they are probably right. On the other hand, do the so-called dinosaur eggs, nests, and tracks lend weight to the Creation, Curse, Catastrophe (CCC) Model of the history of the world? I do not think so! By answering, "Pre-Flood," they or the CCC Model have the problem of explaining these fossils. To do so they follow the teachings of paleontology and historical geology and run smack dab into the problem of time. To resolve this problem they read into the curse of Genesis 3:16–19 all sorts of extra-Biblical catastrophes that may or may not have occurred between the Fall of man and the Flood.

Michael Oard (2003) asks, "Could Dinosaurs Make Tracks and Lay Eggs in the Flood?" My impression is that he thinks the answer is yes. I suppose that these fossil eggs and tracks could have been laid and made during the Flood. But I am not convinced they were. I find it incredible that huge amounts of sediment could have been eroded and deposited in less than 40 days so that the dinosaurs could lay their eggs on thousands of feet of sediment and then leave their tracks and young behind. I find it difficult to put confidence in the results of computer modeling, particularly oscillations in sea level resulting from huge troughs in the flood waters "which would have provided enough land for the dinosaurs to embark. They would have laid eggs and made tracks on the exposed land." (Oard, p. 120). Where the Bible is silent on a question I am forced to use worldly criteria to make a judgment. I have not been convinced from the Bible or by sound reasoning that dinosaurs did make the tracks and lay the eggs found in the sedimentary rock at various places around the world during the Flood.

I would like to see how these fossils are explained by persons other than those who hold the CCC Model or the "augmented" Flood model. For instance, I would like to see how the Catastrophic Plate Tectonics model explains these fossils?

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Oard, Michael J. 2003. Could Dinosaurs Make Tracks and Lay Eggs Early in the Flood? *Creation Research Society Quarterly* 40(2):119–123.

Theodore P. Aufdemberge, Ph.D.

Response to Aufdemberge

I thank the letter writer for his comments about the forum. There are so many issues and differences of opinion within creationism, especially in geology and astronomy, that forums are good, as long as they are conducted in charity. Forums not only give creationists a chance to present their case of why they believe a certain thing, but it also gives others a chance to check the data and the reasoning behind the interpretation of data. The letter writer is concerned with a forum being divisive. We are already divisive, but like a marriage problem, honest communication seems like the way to proceed to improve the situation, just like we are doing in this exchange. Silence is not golden on these many issues that divide. Sure, writers can play fast and loose with scripture and geology, but hopefully the other person or persons on a forum will point out problems. Discerning readers can also write letters and correct such actions.

In regard to the purpose of the Creation Research Society, the letter writer quotes Article I, section 2, as the purpose of the society. That article says that it is the *chief* purpose of the society, not the only purpose. In Article II under "Statement of Belief," the constitution also says in Section 3, "The great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event, worldwide in its extent and effect." Would not another purpose of the society be to catalog evidence for the Flood and to build a Flood model?

The letter writer chides Lain, Gentet, and myself for adding to the words of Genesis that describe the geophysical mechanism of the Flood. We are said to be adding man's ideas to the Bible. Adding man's ideas to the Bible is a definite problem, but what is wrong with starting with the Bible in all our thinking and using the data of His creation and Flood judgment to build the Creation/Flood model? One must, of course, be careful that the data is real and not a biased selection. This procedure is not simply accepting man's opinion. That is why in the area of geology, we must check the data first by field trips and other published literature. I also believe the Lord expects us to use the brain He created. If we see dinosaur fossils in sedimentary rocks, should we not examine all the data available to determine whether the sedimentary rocks are Flood rocks? If Flood rocks, could not we conclude that dinosaurs were real and lived before the Flood and died early in the Flood? To say that possibly God created the bones in the sedimentary rocks, and I suppose the rest of the fossils as well, is unreasonable to me. Of course, others can disagree with the interpretation of dinosaur fossils and should provide reasons for why they disagree.

In regard to the deduction that the few thousand meters of sedimentary rocks below the tracks and eggs are from the Flood is based on the fossils found in these rocks. Furthermore, the great amount of erosion before the dinosaur material is exposed fits in naturally with the Recessional Stage of the Flood. It is true the Bible is silent on the origin of sedimentary rocks, but using our minds that God created, we can deduce from Scripture that sedimentary rocks could be either from the 3rd day of creation, pre-Flood, Flood, or post-Flood. One can eliminate the 3rd day because of the fossils, since the fossils would indicate death before sin (see Romans 5:12). Then we look at the scale of the sedimentary rocks. On the plains of Montana and vicinity, the dinosaur fossils are found in sedimentary rocks that cover several hundred square kilometers on the high plains. Such a large volume of sedimentary rocks is not likely before or after the Flood because of the lack of geological energy and the silence of Scripture on catastrophes during these times. It is a reasonable deduction that the sedimentary rocks with the contained abundant fossils are from the Flood, the only real catastrophe that the Bible describes in Genesis. I would say that we are *not* using man's ideas here, but starting from Scripture and making reasonable deductions from observations. Of course, those who believe the fossils and sedimentary rocks were laid down before the Flood and those who believe they are mostly post-Flood can dissent and state their reasons in an article, forum, or letter.

The letter writer has trouble understanding how I can say the tracks and eggs could be laid down early in the Flood. I have published widely on this topic, and I hope the letter writer has used the scholarly approach and read this literature and understood my hypothesis. But I do not think he understands the hypothesis of exposed Flood sediments early in the Flood. First, I have never said that the huge amount of sedimentary rock below the dinosaur material was laid down within 40 days. I have maintained that Scripture allows up to 150 days. Second, there are a number of mechanisms that would cause sea level to oscillate up and down at many spatial and time scales during a general rise. Barnette and Baumgardner's (1994) computer model of a flooded, shallow-water continent is only one mechanism. There are also tides, possibly with resonance; tsunamis; and waves from tectonics near and far. I might add that when sea level rises in a catastrophic fashion, there will be locations that are catastrophically eroded, and there likely would be sheltered areas on newly exposed Flood sediments to protect eggs and tracks from erosion. Models of course can be problematic and sometimes can be manipulated to arrive at the desired solution, depending upon the physics of the variables, boundary conditions, and initial conditions. However, the physics of the Barnette and Baumgardner model using the shallow water equations is quite simple, and their result of oscillating sea level was only accidentally found. The equations are similar to those that drive the jet stream in the atmosphere. Although their boundary conditions can be questioned, they did run the program with a number of continent sizes and depths that determined current speeds and shallowing of sea level in troughs. Their initial condition for the water velocity was that the water started at rest, the most conservative initial condition. Regardless, the principle is sound: Strong currents will be generated on shallow landmasses of wide extent in a global Flood due to the Coriolis effect. It is possible that such a boundary condition never occurred early in the Flood or anytime in the Flood, in which case it would not apply to sea level. However, there are enough oscillations caused by the other three mechanism for sea level to rise and fall at many scales. These are not ad hoc deductions, but reasonable processes that would occur early in the Flood.

According to the letter writer, we should not make reasonable deductions on the Flood. We would not say anything about sedimentary rocks and fossils, since they are not in the Bible. We would not do research on radiometric dating methods and other time indicators. We could not determine that there was an ice age after the Flood, a reasonable climatic deduction from the Flood, since the ice age is not in the Bible. This attitude would simply give up on the earth sciences to the evolutionary/uniformitarian scientists and allow these scientists to continue to sweep the culture, while we stand around and watch. Thinking Christians would then have no alternative biblical model for geology, and the faith of many would be weakened or swept away. I ask the letter write whether he believes Scripture the key to Earth history or not? If it is, I would rather believe in 2 Peter 3:3–6 that the evidence for the Flood is obvious and that secular man deliberately ignores this abundant evidence. We should be in the business of pointing out the abundant evidence.

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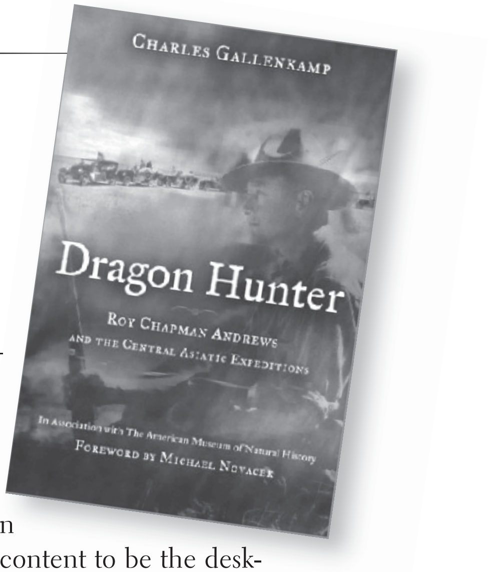
Michael Oard

Book Review

Dragon Hunter: Roy Chapman Andrews and the Central Asiatic Expeditions
by Charles Gallenkamp
Viking Penguin Putnam, Inc, New York, 2001, 344 pp. $29.95


Charles Gallenkamp
Dragon Hunter
Roy Chapman Andrews and the Central Asiatic Expeditions
In Association with The American Museum of Natural History
Foreword by Michael Novacek

As a grade school student fascinated with dinosaurs, I read everything I could find about them. One book stood out: *All About Dinosaurs* by Roy Chapman Andrews. What made this book special was that the author was a field paleontologist with experience in such exotic places as the Gobi desert in Mongolia. The writer of the book under review, Charles Gallenkamp, is himself an archaeologist and seasoned writer. He has thoroughly researched his topic from primary sources and interviews with knowledgeable individuals. This book works on three levels. First, it presents a full-orbed biography of Roy Chapman Andrews. Second, it provides much background for the Central Asian expeditions of the 1920s. It is a story of the personalities, politics, hardships, and adventure that made the paleontogical expeditions unique. Third, it deals with the scientific issues that propelled the expeditions in the first place.

In the years 1906–1919, Andrews developed a reputation as an adventurer/scholar. He was by nature an explorer who thrived on hardship and was never content to be the deskbound administrator that he became in later years. Andrews was hired by the American Museum of Natural History (AMNH) in 1906, where he became an expert on whales. He took trips to Japan and the East Indies to collect vast numbers of zoological specimens. After a number of such adventures, the U.S. government commissioned him to gather intelligence in China during World War I. He was very self-confident, with a natural flair for self-promotion. Because of his varied exploits, Andrews was a popular public speaker. As his fame grew he became a fund-raiser for museum projects such as the Asiatic expeditions.

Henry Fairfield Osborn, the president of the AMNH, took a liking to Andrews and became the younger man's sponsor and mentor during his early years at the museum. Osborn fervently believed that the evolutionary origins of mammalian life, especially human life, were to be found in northern Asia. This was the impetus for the Gobi desert expeditions. There were also racist reasons for the expeditions. "Like many of his colleagues, Osborn espoused the superiority of Caucasian peoples, especially those of Nordic stock. The possibility that man's genesis might have occurred in Africa, the 'Dark Continent,' with its Negroid stigma, was decided unpalatable. Asia, therefore, was far preferable as the 'Cradle of Mankind,' and to Osborn and Andrews proving this hypothesis was almost a sacred duty" (p. 97). While the series of expeditions that extended over a decade turned up treasure troves of mass fossil graveyards of ancient mammals (i.e. mastodon-like Platybelodons, Titanotheres, and giant rhino-like Baluchitheriums) and dinosaurs (i.e. Protoceratops, Oviraptors, Velociraptors, Saurornithodes, iguanodonts), the discovery of any significant remains of fossil man were not found.

The science in this book is designed to be read by the interested lay reader. It contains both corrections to previously-held beliefs and apparent contradictions. It is replete with standard evolutionary/uniformitarian assumptions (i.e., birds being descendants of theropod dinosaurs, p. 320). However, it does correct some decades-held beliefs. In 1923, expedition paleontologist George Olsen discovered the skeleton of a bird-like dinosaur later named Oviraptor above a nest of Protoceratops eggs. The assumption was made that the dinosaur was killed while raiding the egg cluster (p. 173). In 1994, AMNH paleontologist Mark Norell discovered near the same location a cluster of Protoceratops eggs similar to those found by Olsen. One of the eggs had the top worn off by erosion exposing an embryo. The embryo was not a Protoceratops, but an Oviraptor. Over sixty years of scientific fact was overturned by this discovery. The Oviraptor that Olsen found was not trying to steal the eggs, but was probably incubating them.

One seeming contradiction appears in the book. In 1923, expedition fossil collector Albert Johnson made a remarkable discovery. Near Iren Datasu, "...he began clearing the earth... exposing an extensive quarry of dinosaur skeletons representing a variety of species entangled in a jumbled mass. Both flesh-eaters and herbivores were intermingled in the heterogeneous chaos of fossils. They appeared to have been caught in the swirling action of water, perhaps a fast-flowing stream or eddy in which the animals had become mired. Evidence that the area was once wet and thick with vegetation was clear from the large number of crocodiles, turtles, and iguanodontid, lumbering dinosaurs that fed on leaves and succulent plants that grew in wetlands near lakes, marshes, and rivers" (pp. 168–169). Yet modern theorists apparently disregard this evidence. "By contrast, the late Cretaceous environment of the Gobi was much like that of the present day—a relatively dry maze of sand dunes, eroded badlands, wide valleys, and cliffs sparsely watered by seasonal lakes and streams" (p. 311). This, of course, brings up other questions. How could such a marginal climate and environment sustain great populations of large plant-eating dinosaurs and supposedly later gigantic mammals like baluchitherium? Also are we to believe that climates remain essentially stable for 65 million years?

The Gobi desert presents vast quantities of fossil bones and wonderful preservation. "Nor was Andrews able to penetrate the enormous expanses of the western and southern Gobi, which he correctly suspected held vast graveyards of extinct animals. Moreover, many of the sites discovered by his expeditions have since proven inexhaustible. The desert conceals such a wealth of fossils that the relentless process of erosion exposes a bountiful harvest of new specimens every few years" (p. 310). Gallenkamp goes on, "Not only is the Gobi littered with a mind-boggling array of Cretaceous and Cenozoic animals, but most of them are found in a remarkable state of preservation. Everything from tiny skulls of ancient mammals to skeletons of dinosaurs that roamed this area 90 million to 65 million years ago frequently emerge from the earth looking as if they had been buried only a few decades ago"(pp. 310–311). The writer suggests "violent sandstorms" and "brief torrential rains" which caused mudslides sufficient for the mass burial of these animals.

Many small mammals have been found in the Gobi's Cretaceous rocks. Gallenkamp is overcome with Darwinian speculation when he states "...Cretaceous marsupials and placentals—the direct ancestors of the diverse mammals that evolved during the Cenozoic, the Age of Mammals." But several lines later he sobers up by saying, "But exactly how these miniature creatures, scurrying around under the feet of dinosaurs, evolved into the animals that influenced Osborn's thinking is shrouded in aeons of darkness" (p. 320).

This book is a well-written and exciting narrative of a remarkable man and is a good introduction for creationist paleontologists to re-examine the rich fossil evidence of the Gobi in light of Flood and post-Flood catastrophic processes. It contains photo sections, bibliography, and an index.

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Instructions to Authors

Submission

Submit an original plus two copies of each manuscript to the editor of the *Creation Research Society Quarterly* (see the inside front cover for address). Concurrent submission of an electronic version (Word, WordPerfect, or Rich Text Format) of the manuscript text and graphics is also encouraged. The manuscript and graphics will not be returned to authors unless a stamped, self-addressed envelope accompanies submission. Manuscripts containing more than 30 pages are discouraged. An author who determines that the topic cannot be adequately covered within this number of pages is encouraged to submit separate papers that can be serialized.

All submitted manuscripts will be reviewed by two or more technical referees. However, each section editor of the *Quarterly* has final authority regarding the acceptance of a manuscript for publication. While some manuscripts may be accepted with little or no modification, typically editors will seek specific revisions of the manuscript before acceptance. Authors will then be asked to submit revisions based upon comments made by the referees. In these instances, authors are encouraged to submit a detailed letter explaining changes made in the revision, and, if necessary, give reasons for not incorporating specific changes suggested by the editor or reviewer. If an author believes the rejection of a manuscript was not justified, an appeal may be made to the *Quarterly* editor (details of appeal process at the Society's web site, www.creationresearch.org).

Authors who are unsure of proper English usage should have their manuscripts checked by someone proficient in the English language. Also, authors should endeavor to make certain the manuscript (particularly the references) conforms to the style and format of the *Quarterly*. Manuscripts may be rejected on the basis of poor English or lack of conformity to the proper format.

The *Quarterly* is a journal of original writings, and only under unusual circumstances will previously published material be reprinted. Questions regarding this should be submitted to the Editor (*CRSQ* editor@creationresearch. org) prior to submitting any previously published material. In addition, manuscripts submitted to the *Quarterly* should not be concurrently submitted to another journal. Violation of this will result in immediate rejection of the submitted manuscript. Also, if an author uses copyrighted photographs or other material, a release from the copyright holder should be submitted.

Appearance

Manuscripts shall be computer-printed or neatly typed. Lines should be double-spaced, including figure legends, table footnotes, and references. All pages should be sequentially numbered. Upon acceptance of the manuscript for publication, an electronic version is requested (Word, WordPerfect, or Rich Text Format), with the graphics in separate electronic files. However, if submission of an electronic final version is not possible for the author, then a cleanly printed or typed copy is acceptable.

Submitted manuscripts should have the following organizational format:

1. Title page. This page should contain the title of the manuscript, the author's name, and all relevant contact information (including mailing address, telephone number, fax number, and e-mail address). If the manuscript is submitted by multiple authors, one author should serve as the corresponding author, and this should be noted on the title page.

2. Abstract page. This is page 1 of the manuscript, and should contain the article title at the top, followed by the abstract for the article. Abstracts should be between 75 and 200 words in length and present an overview of the material discussed in the article, including all major conclusions. Use of abbreviations and references in the abstract should be avoided. This page should also contain at least five key words appropriate for identifying this article via a computer search.

3. Introduction. The introduction should provide sufficient background information to allow the reader to understand the relevance and significance of the article for creation science.

4. Body of the text. Two types of headings are typically used by the *CRSQ*. A major heading consists of a large font bold print that is centered in column, and is used for each major change of focus or topic. A minor heading consists of a regular font bold print that is flush to the left margin, and is used following a major heading and helps to organize points within each major topic. Do not split words with hyphens, or use all capital letters for any words. Also, do not use bold type, except for headings (italics can be occasionally used to draw distinction to specific words). Italics should not be used for foreign words in common usage, e.g., "et al.", "ibid.", "ca." and "ad infinitum." Previously published literature should be cited using the author's last name(s) and the year of publication (ex. Smith, 2003; Smith and Jones, 2003). If the citation has more than two authors, only the first author's name should appear (ex.

Smith et al., 2003). Contributing authors should examine this issue of the *CRSQ* or consult the society's web site for specific examples as well as a more detailed explanation of manuscript preparation. Frequently used terms can be abbreviated by placing abbreviations in parentheses following the first usage of the term in the text, for example, polyacrylamide electrophoresis (PAGE) or catastrophic plate tectonics (CPT). Only the abbreviation need be used afterward. If numerous abbreviations are used, authors should consider providing a list of abbreviations. Also, because of the variable usage of the terms "microevolution" and "macroevolution," authors should clearly define how they are specifically using these terms. Use of the term "creationism" should be avoided. All figures and tables should be cited in the body of the text, and be numbered in the sequential order that they appear in the text (figures and tables are numbered separately with Arabic and Roman numerals, respectively).

5. **Summary.** A summary paragraph(s) is often useful for readers. The summary should provide the reader an overview of the material just presented, and often helps the reader to summarize the salient points and conclusions the author has made throughout the text.

6. **References.** Authors should take extra measures to be certain that all references cited within the text are documented in the reference section. These references should be formatted in the current *CRSQ* style. (When the *Quarterly* appears in the references multiple times, then an abbreviation to *CRSQ* is acceptable.) The examples below cover the most common types of references:

Robinson, D.A., and D.P. Cavanaugh. 1998. A quantitative approach to baraminology with examples from the catarrhine primates. *CRSQ* 34:196–208.

Lipman, E.A., B. Schuler, O. Bakajin, and W.A. Eaton. 2003. Single-molecule measurement of protein folding kinetics. *Science* 301:1233–1235.

Margulis, L. 1971a. The origin of plant and animal cells. *American Scientific* 59:230–235.

———. 1971b. *Origin of Eukaryotic Cells*. Yale University Press, New Haven, CT.

Hitchcock, A.S. 1971. *Manual of Grasses of the United States*. Dover Publications, New York.

Walker, T.B. 1994. A biblical geologic model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism* (technical symposium sessions), pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.

7. **Tables.** All tables cited in the text should be individually placed in numerical order following the reference section, and not embedded in the text. Each table should have a header statement that serves as a title for that table (see a current issue of the *Quarterly* for specific examples). Use tabs, rather than multiple spaces, in aligning columns within a table. Tables should be composed with *14-point type* to insure proper appearance in the columns of the *CRSQ*.

8. **Figures.** All figures cited in the text should be individually placed in numerical order, and placed after the tables. Do not embed figures in the text. Each figure should contain a legend that provides sufficient description to enable the reader to understand the basic concepts of the figure without needing to refer to the text. Legends should be on a separate page from the figure. All figures and drawings should be of high quality (hand-drawn illustrations and lettering should be professionally done). Patterns, not shading, should be used to distinguish areas within graphs or other figures. Unacceptable illustrations will result in rejection of the manuscript. Authors are also strongly encouraged to submit an electronic version (.cdr, .cpt, .gif, .jpg, and .tif formats) of all figures in individual files that are separate from the electronic file containing the text and tables.

Special Sections

Letters to the Editor:

Submission of letters regarding topics relevant to the society or creation science is encouraged. Submission of letters commenting upon articles published in the *Quarterly* will be published two issues after the article's original publication date. Authors will be given an opportunity for a concurrent response. No further letters referring to a specific *Quarterly* article will be published. Following this period, individuals who desire to write additional responses/comments (particularly critical comments) regarding a specific *Quarterly* article are encouraged to submit their own articles to the *Quarterly* for review and publication.

Editor's Forum:

Occasionally, the editor will invite individuals to submit differing opinions on specific topics relevant to the *Quarterly*. Each author will have opportunity to present a position paper (1000 words), and one response (500 words) to the differing position paper. In all matters, the editor will have final and complete editorial control. Topics for these forums will be solely at the editor's discretion, but suggestions of topics are welcome.

Book Reviews:

All book reviews should be submitted to the book review editor, who will determine the acceptability of each submitted review. Book reviews should be limited to 1000 words. Following the style of reviews printed in this issue, all book reviews should contain the following information: book title, author, publisher, publication date, number of pages, and retail cost. Reviews should endeavor to present the salient points of the book that are relevant to the issues of creation/evolution. Typically, such points are accompanied by the reviewer's analysis of the book's content, clarity, and relevance to the creation issue.

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3. **Student Member** .... Those who are enrolled full time in high school or undergraduate college.
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5. **Life Member** .... A special category for voting and sustaining members entitling them to a lifetime membership to the Society.
6. **Patron Member** .... A special category for voting and sustaining members who either make a one-time $2,500 contribution to the Society's general fund, or contribute $500/year for five years. A Patron Member receives a life-time subscription, a plaque, and has his or her name listed in the Quarterly each year.
7. **Subscriber** .... Libraries, churches, schools, etc., and individuals who do not subscribe to the Statement of Belief.

All members (categories 1–6 above) must subscribe to the Statement of Belief as defined on the next page.

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Creation Research Society

History—The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (graduate degrees in science) and about 1000 non-voting members. The Creation Research Society Quarterly has been gradually enlarged and improved and now is recognized as the outstanding publication in the field. In 1996 the CRSQ was joined by the newsletter Creation Matters as a source of information of interest to creationists.

Activities—The society is a research and publication society. A limited number of meetings and promotional activities take place. There is no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. As part of its vigorous research and field study programs, the Society operates The Van Andel Creation Research Center in Chino Valley, Arizona.

Membership—Voting membership is limited to scientists who have at least an earned graduate degree in a natural or applied science and subscribe to the Statement of Belief. Sustaining membership is available for those who do not meet the academic criterion for voting membership, but do subscribe to the Statement of Belief.

Statement of Belief—Members of the Creation Research Society, which include research scientists representing various fields of scientific inquiry, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution) both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.
4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The act of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.